August 1, 2018
Ms. Kafi Howard
Town of Blacksburg, Town Engineer
400 South Main Street
Blacksburg, Virginia 24060

RE: 1222 Patrick Henry PRD Application
        B&A Job #24180058.00

Dear Kafi,

Included in this packet are the Stormwater Management calculations for the proposed
1222 Patrick Henry PRD application. If you have any questions or comments please feel
free to call.

Thank you for all of your and the staff's assistance with this project.

Sincerely,
BALZER AND ASSOCIATES, INC.

Steven M. Semones, LA
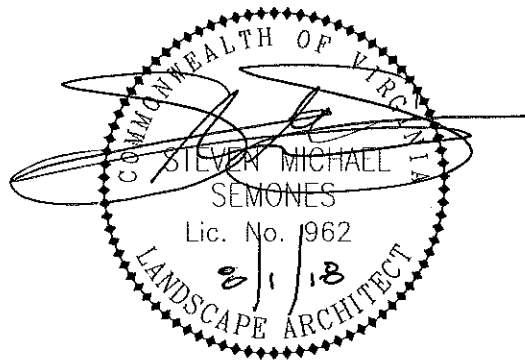Vice President

STORMWATER MANAGEMENT CALCULATIONS

FOR

1222 PATRICK HENRY
PRD APPLICATION

1222 PATRICK HENRY DRIVE

PRICES FORK MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, VA

B&A Job #24180058.00

AUGUST 1, 2018

PREPARED BY:

BALZER AND ASSOCIATES, INC.
448 PEPPERS FERRY ROAD
CHRISTIANSBURG, VIRGINIA 24073
P-540-381-4290
F-540-381-4291

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SECTION I: PROJECT NARRATIVE

Project Description

The purpose of this project is the redevelopment of 4.215 acres of land to a PRD for Green Valley Builders. The site is located at 1222 Patrick Henry Drive in the Town of Blacksburg.

Existing Site Conditions

The site[1] proposed for rezoning is approximately 4.215 acres. There is currently an existing house on the site. The ground cover is mostly grass with some trees. The site is bound by Patrick Henry Drive to the south, the Blacksburg Rescue Squad to the west, Town of Blacksburg open space to the north, and Hunters Ridge Apartments to the east. Existing soil conditions on-site are listed below. There are no wetlands or jurisdictional waters present on site. There are currently no stormwater management BMPs serving the site. Surrounding areas consist of developed urban land including commercial uses, multi-family residential, and single family residential.

Existing soil conditions on-site include the following types:

(See attached soils map and plans for specific locations.)

11C - Duffield-Ernest Complex, 7 to 15 percent slopes
    K Factor: 0.28
    Texture: Silt Loam
    Hydrologic Soil Group: B

12C - Frederick and Vertrees Silt Loams, 7 to 15 percent slopes
    K-Factor: 0.37
    Texture: Silt Loam
    Hydrologic Soil Group: B

18C - Groseclose-Urban Land Complex, 7 to 15 percent slopes
    K Factor: 0.32
    Texture: Loam
    Hydrologic Soil Group: C

Development Plans

The proposed development will remove the existing structures and build a new four-story apartment building. Surface parking will be provided around the building. An outdoor amenity area will be provided in a courtyard area and a clubhouse area will be provided indoors. A total of 276 bedrooms is proposed. The proposed site will also include sidewalk around the building, a connection to the existing public trail behind the site and a stormwater management facility. There is currently a Blacksburg Transit stop across Patrick Henry Drive, and a new stop on the project side of the street is proposed to be installed with this development.

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[1] For the purposes of the Project Narrative, "site" shall be defined as the area within the subject property boundary, 4.215 acres, Tax Map #196-A 5.

During Construction

The existing site consists of stabilized grasses areas that may become disturbed during construction activities. Any runoff from the site will be controlled with temporary measures such as a construction entrance, silt fence, inlet protection, sediment traps or basins, diversion dikes, seeding, and other measures per Virginia Erosion and Sediment Control Handbook standards.

Permanent Structures to Remain After Construction

After construction is complete, permanent ESC measures will be used for stabilization as needed. This will include measures such as permanent seeding, blankets and matting, and outlet protection, as well as anything else that is found to be necessary as design is finalized. There are two HUC's receiving waters from this site. Approximately half of the site drains to NE59 (New River-Stroubles Creek) while the other half drains to NE 60 (Toms Creek-Poverty Creek).

SECTION II: STORMWATER MANAGEMENT SUMMARY

PRE-DEVELOPMENT SUMMARY

Please see sheet SW3 for drainage area map.

In the pre-development condition, the site is split into two distinct drainage areas. Runoff from Drainage Area #1 (approximately 8.00 acres total, with 1.98 acres coming from the project site) drains in a northwesterly direction towards the rear of the property, where it flows through an existing bioswale and under Progress Street by way of a 36" culvert. This culvert outfalls to a natural channel. From this point, runoff continues through a series of channels to Tom's Creek. Point of Analysis #1 has been set at the outfall of the 36" culvert.

Runoff from Drainage Area #2 (approximately 9.34 acres, with 2.23 acres coming from the project site) flows towards Patrick Henry Drive, where it is captured by curb inlets in the right of way and then carried across the street and into an existing detention pond. From this pond, flows continue through a combination of manmade and natural channels to the Duck Pond. Point of Analysis #2 has been set in the storm sewer on the southern side of Patrick Henry Drive.

There are no existing BMPs on the site or upstream of the development. All flows in this model have been analyzed using the SCS/TR-55, weighted Q method. See HydroCAD report for time of concentration calculations. Where a subwatershed is predominantly impervious, a minimum time of concentration of 6 minutes has been assumed.

Point of Analysis #1

Total Contributing Drainage Area = 8.00 acres

PRE-DEVELOPMENT LAND COVER

DESCRIPTION	AREA (AC)	SOIL TYPE	CN
OPEN SPACE	0.451	B	61
OPEN SPACE	1.433	C	74
WOODS	0.923	B	55
WOODS	0.285	C	70
RESIDENTIAL – 1/2 ACRE LOTS	0.164	B	70
RESIDENTIAL – 1/2 ACRE LOTS	0.371	C	80
RESIDENTIAL – 1/4 ACRE LOTS	0.282	B	75
RESIDENTIAL – 1/4 ACRE LOTS	0.496	C	83
MULTI-FAMILY RESIDENTIAL	0.044	B	85
URBAN COMMERCIAL	0.685	B	92
URBAN COMMERCIAL	2.402	C	94
ROW W/ CURB & GUTTER	0.047	B	98
ROW W/ CURB & GUTTER	0.209	C	98
IMPERVIOUS	0.104	B	98
IMPERVIOUS	0.101	C	98

The CN value has been determined based upon soil type information obtained from the NRCS Web Soil Survey. All land covers are assumed to be in good condition and have been estimated from USGS mapping, aerial photography, and Town of Blacksburg GIS maps. All SCS land cover values were taken from Table 4-6a and Table 4-6b of the Virginia Stormwater Management Handbook. Rational "C" coefficients are derived from VSMH Table 4-3 "Rational Equation Runoff Coefficients".

The peak pre-development runoff flows at Point of Analysis #1 are as follows:
(See HydroCAD report)

1-year	**3.67 cfs**
2-year	**4.96 cfs**
10-year	**8.69 cfs**
100-year	**14.90 cfs**

Point of Analysis #2

Total Contributing Drainage Area = 9.34 acres

PRE-DEVELOPMENT LAND COVER

DESCRIPTION	AREA (AC)	SOIL TYPE	CN
OPEN SPACE	0.106	B	61
OPEN SPACE	1.061	C	74
WOODS	0.081	B	55
WOODS	1.159	C	70
MULTI-FAMILY RESIDENTIAL	0.326	B	85
MULTI-FAMILY RESIDENTIAL	4.881	C	90
ROW W/ CURB & GUTTER	0.028	B	98
ROW W/ CURB & GUTTER	0.285	C	98
IMPERVIOUS	1.415	C	98

The CN value has been determined based upon soil type information obtained from the NRCS Web Soil Survey. All land covers are assumed to be in good condition and have been estimated from USGS mapping, aerial photography, and Town of Blacksburg GIS maps. All SCS land cover values were taken from Table 4-6a and Table 4-6b of the Virginia Stormwater Management Handbook. Rational "C" coefficients are derived from VSMH Table 4-3 "Rational Equation Runoff Coefficients".

The peak pre-development runoff flows at Point of Analysis #2 are as follows:
(See HydroCAD report)

1-year	**14.06 cfs**
2-year	**18.37 cfs**
10-year	**28.51 cfs**
100-year	**42.49 cfs**

POST-DEVELOPMENT SUMMARY

Please see sheet SW4 for drainage area map and sheet SW5 for the stormwater management plan.

In the post development condition, the site will remain separated into two drainage areas. Two underground stormwater detention systems (one for each area) have been incorporated to manage and control runoff. Both systems have been designed to manage peak flows and meet all applicable water quantity requirements.

Please see the following pages and the enclosed HydroCAD report for a post development analysis of each drainage area.

Point of Analysis #1

The proposed underground system for Drainage Area #1 is located on the far western side of the site in the parking area. A small amount of drainage from the right of way will be rerouted to flow through the onsite system. Approximately 2.27 acres will drain to the system, with runoff being captured by curb and gutter and drainage inlets. The system will outfall at the rear of the site and runoff will flow through the existing bioswale. See below and enclosed HydroCAD calculations.

Total Drainage Area= 8.27 acres

POST-DEVELOPMENT LAND COVER

DESCRIPTION	AREA (AC)	SOIL TYPE	CN
OPEN SPACE	0.609	B	61
OPEN SPACE	0.808	C	74
WOODS	0.270	B	55
WOODS	0.076	C	70
RESIDENTIAL – 1/2 ACRE LOTS	0.164	B	70
RESIDENTIAL – 1/2 ACRE LOTS	0.371	C	80
RESIDENTAL – 1/4 ACRE LOTS	0.282	B	75
RESIDENTIAL – 1/4 ACRE LOTS	0.496	C	83
RESIDENTIAL – MULTI-UNIT	0.044	B	85
URBAN COMMERCIAL	0.685	B	92
URBAN COMMERCIAL	2.402	C	94
ROW W/ CURB & GUTTER	0.047	B	98
ROW W/ CURB & GUTTER	0.209	C	98
IMPERVIOUS	0.407	B	98
IMPERVIOUS	1.406	C	98

The CN value has been determined based upon soil type information obtained from the NRCS Web Soil Survey. All land covers are assumed to be in good condition and have been estimated from USGS mapping, aerial photography, and Town of Blacksburg GIS maps. All SCS land cover values were taken from Table 4-6a and Table 4-6b of the Virginia Stormwater Management Handbook. Rational "C" coefficients are derived from VSMH Table 4-3 "Rational Equation Runoff Coefficients".

The peak post-development runoff flows at the point of analysis are as follows:
(See HydroCAD report)

1-year	**3.39 cfs**
2-year	**4.89 cfs**
10-year	**8.46 cfs**
100-year	**15.35 cfs**

As shown above, the post-development flow at the Point of Analysis is less than the pre-development flow for the 1-year, 2-year, and 10-year storms, meeting the Town of Blacksburg stormwater management requirements.

Point of Analysis #2

The proposed underground stormwater system for Drainage Area #2 is located on the eastern side of the site, in the greenspace in front of the building. A small amount of offsite drainage will also be rerouted through this system. Approximately 2.27 acres will drain to the system as well, with runoff being captured by curb and gutter and drainage inlets. The system will outfall to a new manhole (labeled as "MH-A" on the plan), which will replace an existing curb inlet ("EX-1"). The curb inlet will need to be replaced due to the addition of the bus pull off lane. See below and enclosed HydroCAD calculations.

Total Drainage Area= 9.03 acres

POST-DEVELOPMENT LAND COVER

DESCRIPTION	AREA (AC)	SOIL TYPE	CN
OPEN SPACE	0.177	B	61
OPEN SPACE	0.665	C	74
WOODS	0.064	B	55
WOODS	0.074	C	70
RESIDENTIAL – MULTI-UNIT	0.326	B	85
RESIDENTIAL – MULTI-UNIT	4.878	C	90
PAVED ROADS/RIGHT OF WAY	0.028	B	98
PAVED ROADS/RIGHT OF WAY	1.519	C	98
IMPERVIOUS	0.131	B	98
IMPERVIOUS	1.172	C	98

The CN value has been determined based upon soil type information obtained from the NRCS Web Soil Survey. All land covers are assumed to be in good condition and have been estimated from USGS mapping, aerial photography, and Town of Blacksburg GIS maps. All SCS land cover values were taken from Table 4-6a and Table 4-6b of the Virginia Stormwater Management Handbook. Rational "C" coefficients are derived from VSMH Table 4-3 "Rational Equation Runoff Coefficients".

The peak post-development runoff flows at the point of analysis are as follows:
(See HydroCAD report)

1-year	**13.79 cfs**
2-year	**17.83 cfs**
10-year	**26.91 cfs**
100-year	**50.06 cfs**

As shown above, the post-development flow at the Point of Analysis is less than the pre-development flow for the 1-year, 2-year, and 10-year storms, meeting the Town of Blacksburg stormwater management requirements.

Channel Protection

In accordance with 9VAC25-870-66 (B), concentrated stormwater flows have been discharged directly to a stormwater conveyance system. The portion of the site[2] that discharges to Point of Analysis #1 outfalls to an existing bioswale and then travels through a series of natural conveyance systems to its 1% analysis point (approximately 228 acres). The portion of the site that discharges to Point of Analysis #2 outfalls to a manhole and travels first through a series storm pipes to an existing pond, then through a series of natural channels to its 1% analysis point (approximately 218 acres). Both drainage areas have met the requirements of channel protection per 9VAC25-870-66(B)(3) as shown below:

R_v Calculation – DA #1
Pre-developed = 0.068 acre*ft – See HydroCAD "RV Calculation" Report
Developed = 0.298 acre*ft – See HydroCAD "RV Calculation" Report

$$Q_{Developed} \le I.F. \text{ x } (Q_{Pre-developed} \text{ x } RV_{Pre-Developed}) / RV_{Developed}$$

$$Q_{Developed} \le 0.8 \text{ x } (Q_{Pre-developed} \text{ x } 0.068) / 0.298$$

$$Q_{Developed} \le 0.18 \text{ x } Q_{Pre-developed}$$

The resulting maximum allowable peak flow rate for the one-year 24-hour storm at Point of Analysis #1 is 3.41 cfs and the actual post-development peak flow achieved is 3.39 cfs.

R_v Calculation – DA #2
Pre-developed = 0.117 acre*ft – See HydroCAD "RV Calculation" Report
Developed = 0.276 acre*ft – See HydroCAD "RV Calculation" Report

$$Q_{Developed} \le I.F. \text{ x } (Q_{Pre-developed} \text{ x } RV_{Pre-Developed}) / RV_{Developed}$$

$$Q_{Developed} \le 0.8 \text{ x } (Q_{Pre-developed} \text{ x } 0.117) / 0.276$$

$$Q_{Developed} \le 0.34 \text{ x } Q_{Pre-developed}$$

The resulting maximum allowable peak flow rate for the one-year 24-hour storm at Point of Analysis #2 is 13.94 cfs and the actual post-development peak flow rate achieved is 13.79 cfs.

Flood Protection

In accordance with 9VAC25-870-66 (C), concentrated stormwater flows have been discharged directly to a stormwater conveyance system.

For Drainage Area #1, the flow is discharged to an existing bioswale and is then carried through a natural stormwater conveyance system. This system carries flows to a point where the contributing drainage area is less than or equal to 1.0% of the total watershed area as defined in subdivision 3(a) of the regulations (at least 228 acres).

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[2] In the context of channel and flood protection, "site" shall be defined as the land or water area where the land-disturbing activity is physically conducted (the area of land disturbance, approx. 4.46 acres), including the limits of any off-site land disturbance. See Sheets SW3-SW4.

For Drainage Area #2, the flow is discharged to an existing manhole, then carried through a series of storm pipes to an existing pond. Once the flow exits the pond, it is carried through a natural conveyance system to a point where the contributing drainage area is less than or equal to 1.0% of the total watershed area as defined in subdivision 3(a) of the regulations (at least 218 acres).

As shown on the attached HydroCAD calculations, the point of discharge for each drainage area releases a post-development peak flow rate for the 10-year 24-hour storm event that is less than the pre-development peak flow rate from the 10-year 24-hour storm event, satisfying subdivision 2(b). Per subdivision (3), no further analysis of the downstream stormwater conveyance system is required.

SECTION III: STORMWATER QUALITY SUMMARY

Water quality compliance has been achieved through use of the Virginia Runoff Reduction Method in accordance with the design criteria set forth in 9VAC25-870-65 and through the purchase of nutrient credits in accordance with the criteria set forth in the Code of Virginia. Per §62.1-44.15:35 (C)(2), the VSMP shall allow the use of nutrient credits when less than five acres of land will be disturbed or the phosphorus water quality reduction requirement is less than 10 pounds per year. The proposed development is within the thresholds for permitted use of credits, with a disturbance area of approximately 4.46 acres and a required phosphorus load reduction of 5.16 lb/yr.

The existing site[3] is a single-family lot with a house and shed located on it. The pre-development site has an impervious land cover of 0.35 acres (7.85%). The post development site has an impervious land cover of 3.10 acres (69.5%), resulting in a composite runoff coefficient (R_v) of 0.72. The prescribed phosphorus pollutant reduction requirement is 5.16 lb/yr, which will be handled by purchasing credits. Please see attached calculation sheets.

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[3] In the context of water quality compliance, "site" shall be defined as the land or water area where the land-disturbing activity is physically conducted (the area of land disturbance, 4.46 acres), including the limits of any off-site land disturbance. See Sheets SW3-SW4.

SECTION IV: DOWNSTREAM ANALYSIS

Runoff from Drainage Area #1 is discharged to an existing bioswale and is then carried through a natural conveyance system towards its 1% analysis point. Runoff from Drainage Area #2 is discharged directly to a manmade stormwater conveyance system and is then carried through a series of storm pipes to an existing pond. Once runoff leaves the pond, it enters a natural conveyance system and is carried through a combination of manmade and natural conveyance systems towards its 1% analysis point. The post development peak runoff rate for each drainage area has been mitigated through the use of BMP's to prevent adverse impacts to downstream properties in the form of channel erosion, flooding, or increased pollutant loads.

Per 9VAC25-870-66 subsection A, compliance with Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations has been satisfied by meeting the requirements of the for channel protection and flood protection as shown in the Post Development Summary. No adverse impacts to downstream properties are expected as a result of this development.

SECTION V: STORMWATER MANAGEMENT MAINTENANCE/INSPECTION PLAN

Generally:

1. The owner is responsible for providing or coordinating all facility inspections and any required maintenance that may result from such inspections.
2. Requirements listed here are to be taken as a minimum and do not represent the limit of responsibility.
3. Any standing water pumped during the maintenance operation must be disposed of per the VESCH, 1992 edition and any local requirements.

Required Action:

Underground Detention Facilities:

1. Every (6) months and after each major runoff producing storm event, a maintenance visit shall be performed and documented, and any repairs necessary to areas of failure/concern discovered during inspection shall be carried out. Typical maintenance tasks include:
   a. Cleanout of any debris or sediment accumulated in the structure that reduces the storage volume or otherwise hinders the performance of the facility.
   b. Visual inspection for structural deterioration, spalling, or cracking of the structural components.
2. The flow control manholes shall be inspected after each runoff producing storm event to check for debris and/or sediment accumulation that may compromise the performance of the structure. Such debris and sediments shall be removed immediately.

Per the Town of Blacksburg stormwater ordinance, a formal maintenance agreement shall be provided to the Town for review and ultimately recorded at the Montgomery County Courthouse legally binding the identified party to the maintenance/inspection responsibilities listed above.

SECTION VI: ALTERNATIVE STORMWATER MANAGEMENT PLAN

We have shown with the above calculations and enclosed HydroCAD report that stormwater runoff can be managed through the use of underground detention facilities on site and that all town and state requirements are able to be met. However, we plan to explore an alternative option prior to submitting for site plan approval. Instead of installing two systems on site, we will look at the possibility of taking all stormwater runoff offsite to an existing town-owned stormwater detention pond located at the southern end of the Collegiate Suites community. A field survey of the existing pond will be completed and all existing storm pipes currently draining to the pond will be analyzed. If it is determined that this is a practical and affordable option, we will submit a full analysis and design plan showing any improvements needed for the pond and existing storm sewer system.

APPENDIX A:
SOIL MAPS & SOIL DESCRIPTIONS

Custom Soil Resource Report for
Montgomery County, Virginia

May 31, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

11C

12C

18C

Patrick Henry Dr

Soil Map may not be valid at this scale.

Map Scale: 1:1,210 if printed on A landscape (11" x 8.5") sheet.

Meters
0   15   30   60   90

Feet
0   50   100   200   300

N

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

☐ Area of Interest (AOI)

Soils

☐ Soil Map Unit Polygons

〰 Soil Map Unit Lines

■ Soil Map Unit Points

Special Point Features

◉ Blowout

⊠ Borrow Pit

✳ Clay Spot

◇ Closed Depression

✕ Gravel Pit

∴ Gravelly Spot

⊛ Landfill

Λ Lava Flow

⚓ Marsh or swamp

⚒ Mine or Quarry

◎ Miscellaneous Water

◯ Perennial Water

˅ Rock Outcrop

╋ Saline Spot

∴ Sandy Spot

⊜ Severely Eroded Spot

◊ Sinkhole

⇗ Slide or Slip

⌀ Sodic Spot

▤ Spoil Area

◔ Stony Spot

⚇ Very Stony Spot

⍦ Wet Spot

△ Other

⊶ Special Line Features

Water Features

〜 Streams and Canals

Transportation

╬ Rails

〜 Interstate Highways

〜 US Routes

〜 Major Roads

〜 Local Roads

Background

▨ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 10, Oct 3, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 22, 2012—Feb 5, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
11C	Duffield-Ernest complex, 7 to 15 percent slopes	0.2	4.5%
12C	Frederick and Vertrees silt loams, 7 to 15 percent slopes	0.6	14.2%
18C	Groseclose-Urban land complex, 7 to 15 percent slopes	3.4	81.3%
Totals for Area of Interest		**4.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Montgomery County, Virginia

11C—Duffield-Ernest complex, 7 to 15 percent slopes

Map Unit Setting

National map unit symbol: kc1r
Elevation: 1,300 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Duffield and similar soils: 45 percent
Ernest and similar soils: 35 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Duffield

Setting

Landform: Drainageways
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvial, alluvial, eolian sediments underlain by loamy and clayey residuum of limestone and shale

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 37 inches: silty clay loam
H3 - 37 to 79 inches: clay

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: 48 to 99 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Ernest

Setting

Landform: Drainageways

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Interbedded limestone and shale residuum

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 26 inches: silty clay loam
H3 - 26 to 50 inches: silty clay loam
H4 - 50 to 79 inches: silty clay loam

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: 20 to 35 inches to fragipan
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Purdy

Percent of map unit: 3 percent
Landform: Depressions, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

12C—Frederick and Vertrees silt loams, 7 to 15 percent slopes

Map Unit Setting

National map unit symbol: kc1t
Elevation: 1,700 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Frederick and similar soils: 40 percent
Vertrees and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Frederick

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone interbedded with siltstone and shale residuum

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 22 inches: clay
H3 - 22 to 79 inches: clay

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to
   high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Forage suitability group: Moist, Fertile Soils (G128XB001VA)
Hydric soil rating: No

Description of Vertrees

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, siltstone, and shale residuum

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 25 inches: silty clay
H3 - 25 to 50 inches: clay
H4 - 50 to 79 inches: clay

Properties and qualities

Slope: 7 to 15 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Forage suitability group: Moist, Fertile Soils (G128XB001VA)
Hydric soil rating: No

18C—Groseclose-Urban land complex, 7 to 15 percent slopes

Map Unit Setting

National map unit symbol: kc28
Elevation: 1,300 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Groseclose and similar soils: 40 percent
Urban land: 30 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Groseclose

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 28 inches: clay
H3 - 28 to 39 inches: clay
H4 - 39 to 51 inches: clay
H5 - 51 to 79 inches: clay loam

Properties and qualities

Slope: 7 to 15 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C

Hydric soil rating: No

Description of Urban Land

Setting

Landform: Hills

Landform position (two-dimensional): Backslope, summit

Landform position (three-dimensional): Interfluve, side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Limestone, shale, siltstone, and sandstone residuum

Minor Components

Purdy

Percent of map unit: 3 percent

Landform: Depressions, stream terraces

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.
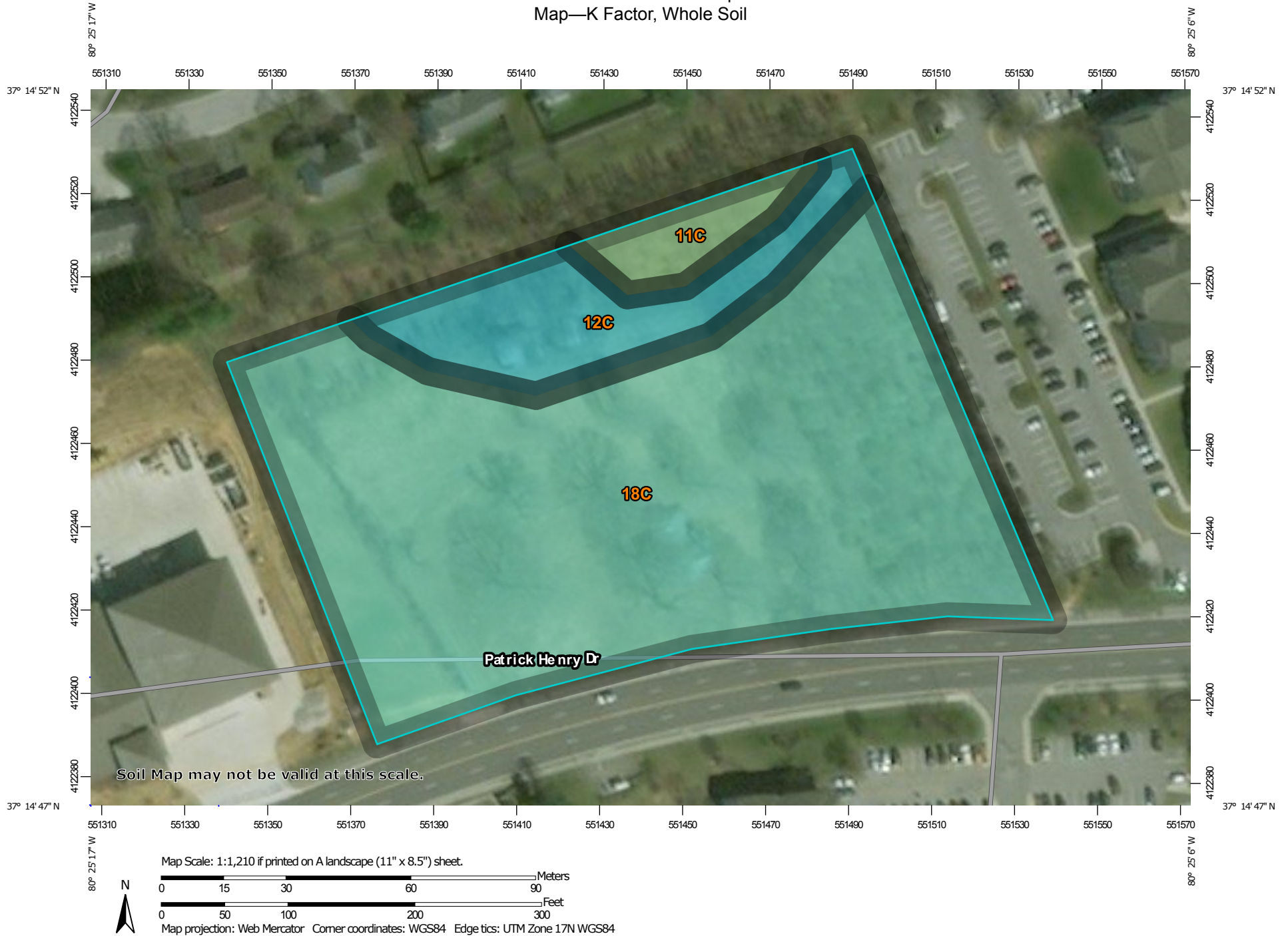
11C

12C

18C

Patrick Henry Dr

Soil Map may not be valid at this scale.

Map Scale: 1:1,210 if printed on A landscape (11" x 8.5") sheet.

N

	Meters
0 15 30 60	90

	Feet
0 50 100 200	300

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

☐ Area of Interest (AOI)

Soils

Soil Rating Polygons

🟥	.02
🟧	.05
🟧	.10
🟨	.15
🟨	.17
🟩	.20
🟩	.24
🟩	.28
🟦	.32
🟦	.37
🟦	.43
🟦	.49
🟪	.55
🟪	.64
⬜	Not rated or not available

Soil Rating Lines

∿	.02
∿	.05
∿	.10
∿	.15
∿	.17
∿	.20

∿	.24
∿	.28
∿	.32
∿	.37
∿	.43
∿	.49
∿	.55
∿	.64
∿	Not rated or not available

Soil Rating Points

🟥	.02
🟧	.05
🟧	.10
🟨	.15
🟨	.17
🟩	.20
🟩	.24
🟩	.28
🟩	.32
🟦	.37
🟦	.43
🟦	.49
🟦	.55
🟦	.64
⬜	Not rated or not available

Water Features

☁ Streams and Canals

Transportation

┼┼┼	Rails
∿	Interstate Highways
∿	US Routes
∿	Major Roads
∿	Local Roads

Background

▨ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 10, Oct 3, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 22, 2012—Feb 5, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11C	Duffield-Ernest complex, 7 to 15 percent slopes	.28	0.2	4.5%
12C	Frederick and Vertrees silt loams, 7 to 15 percent slopes	.37	0.6	14.2%
18C	Groseclose-Urban land complex, 7 to 15 percent slopes	.32	3.4	81.3%
Totals for Area of Interest			**4.2**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Surface Texture

This displays the representative texture class and modifier of the surface horizon.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

11C

12C

18C

Patrick Henry Dr

Soil Map may not be valid at this scale.

Map Scale: 1:1,210 if printed on A landscape (11" x 8.5") sheet.

				Meters
0	15	30	60	90

				Feet
0	50	100	200	300

N

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
☐ Area of Interest (AOI)

Soils

Soil Rating Polygons
☐ Loam

☐ Silt loam

☐ Not rated or not available

Soil Rating Lines
〰 Loam

〰 Silt loam

〰 Not rated or not available

Soil Rating Points
■ Loam

■ Silt loam

☐ Not rated or not available

Water Features
〰 Streams and Canals

Transportation
╫ Rails

〰 Interstate Highways

〰 US Routes

〰 Major Roads

〰 Local Roads

Background
Aerial Photography

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Surface Texture

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11C	Duffield-Ernest complex, 7 to 15 percent slopes	Silt loam	0.2	4.5%
12C	Frederick and Vertrees silt loams, 7 to 15 percent slopes	Silt loam	0.6	14.2%
18C	Groseclose-Urban land complex, 7 to 15 percent slopes	Loam	3.4	81.3%
Totals for Area of Interest			**4.2**	**100.0%**

Rating Options—Surface Texture

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

MAP LEGEND

Area of Interest (AOI)
- ☐ Area of Interest (AOI)

Soils

Soil Rating Polygons
- ☐ A
- ☐ A/D
- ☐ B
- ☐ B/D
- ☐ C
- ☐ C/D
- ☐ D
- ☐ Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- ☐ A
- ☐ A/D
- ☐ B
- ☐ B/D

- ☐ C
- ☐ C/D
- ☐ D
- ☐ Not rated or not available

Water Features
- ～ Streams and Canals

Transportation
- +++ Rails
- ～ Interstate Highways
- ～ US Routes
- ～ Major Roads
- ～ Local Roads

Background
- Aerial Photography

MAP INFORMATION

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Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11C	Duffield-Ernest complex, 7 to 15 percent slopes	B	0.2	4.5%
12C	Frederick and Vertrees silt loams, 7 to 15 percent slopes	B	0.6	14.2%
18C	Groseclose-Urban land complex, 7 to 15 percent slopes	C	3.4	81.3%
Totals for Area of Interest			**4.2**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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APPENDIX B:
DRAINAGE MAPS

POINT OF ANALYSIS #1

PROGRESS STREET
50' R/W

AREA DRAINING TO POA #1
AREA=±8.00 AC
CN=81

408 LF SCF
@ 5.64%

440 LF SCF
@ 3.96%

150 LF OLF @
2.67%

60 LF SCF
@ 3.33%

225 LF SCF
@ 7.11%

APPROXIMATE LIMITS OF DISTURBANCE
(WATER QUALITY AREA)

AREA BYPASSING EX-1
AREA=±7.10 AC
CN=90

AREA DRAINING TO EX-1
AREA=±2.24 AC
CN=76

EXISTING
INLET "EX-1"

EXISTING
INLET "EX-2"

PATRICK HENRY DR.
R/W WIDTH VARIES

SENECA DR.
50' R/W

POINT OF ANALYSIS #2
(EXISTING INLET "EX-3")
TOTAL CDA=9.34 AC

1222 PATRICK HENRY PRD
1222 PATRICK HENRY DRIVE
PRE-DEVELOPMENT DRAINAGE AREA MAP
PRICES FORK MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, VIRGINIA

DRAWN BY   GLM
DESIGNED BY   GLM
CHECKED BY   SMS
DATE   8/1/18
SCALE   1"=60'
REVISIONS:

LEGEND

STRM ▬▬▬	EXISTING STORM SEWER
	PROPERTY LINE
	EASEMENT LINE
	STREAM
	HSG B SOILS
	HSG C SOILS

APPROVAL BLOCK

BLACKSBURG TOWN PLANNER

BLACKSBURG TOWN ENGINEER

60 0 60 120 180

SCALE: 1" = 60'

SHEET NO.
SW3

JOB NO. 24180058.00
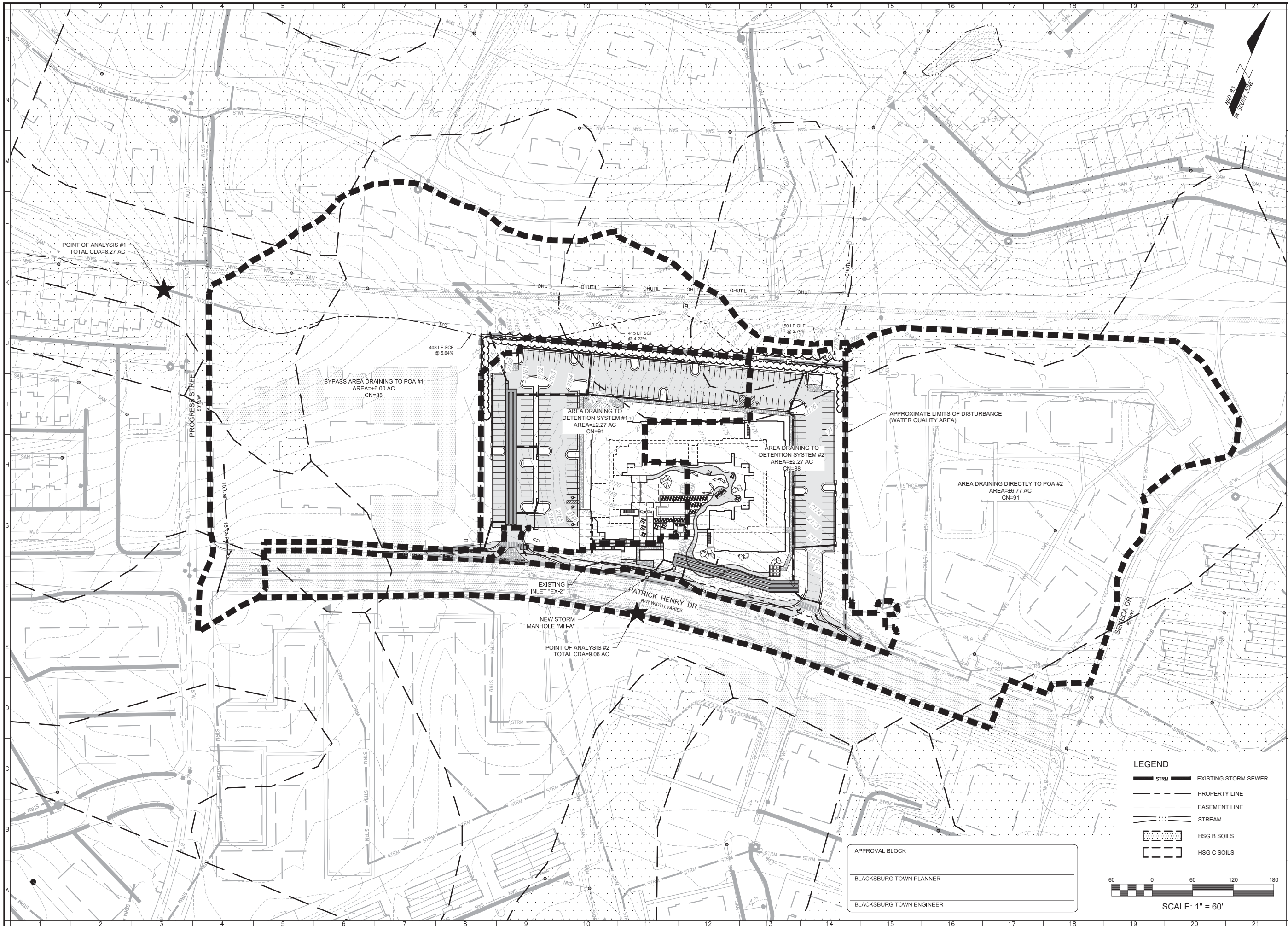
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448 Peppers Ferry Road, NW
Christiansburg, VA 24073
540-381-4290
FAX 540-381-4291

STEVEN MICHAEL SEMONES
Lic. No. 962
8/1/18
LANDSCAPE ARCHITECT

POINT OF ANALYSIS #1
TOTAL CDA=8.27 AC

BYPASS AREA DRAINING TO POA #1
AREA=±6.00 AC
CN=85

408 LF SCF
@ 5.64%

415 LF SCF
@ 4.22%

150 LF OLF
@ 2.70%

AREA DRAINING TO
DETENTION SYSTEM #1
AREA=±2.27 AC
CN=91

AREA DRAINING TO
DETENTION SYSTEM #2
AREA=±2.27 AC
CN=88

APPROXIMATE LIMITS OF DISTURBANCE
(WATER QUALITY AREA)

AREA DRAINING DIRECTLY TO POA #2
AREA=±6.77 AC
CN=91

PROGRESS STREET
50' R/W

EXISTING
INLET "EX-2"

NEW STORM
MANHOLE "MHA"

PATRICK HENRY DR.
R/W WIDTH VARIES

SENECA DR.
R/W

POINT OF ANALYSIS #2
TOTAL CDA=9.06 AC

1222 PATRICK HENRY PRD
1222 PATRICK HENRY DRIVE
POST-DEVELOPMENT DRAINAGE AREA MAP
PRICES FORK MAGISTERIAL DISTRICT
TOWN OF BLACKSBURG, VIRGINIA

DRAWN BY   GLM
DESIGNED BY   GLM
CHECKED BY   SMS
DATE   8/1/18
SCALE   1"=60'
REVISIONS:

LEGEND

STRM ━━━ EXISTING STORM SEWER
─ ─ ─ PROPERTY LINE
───── EASEMENT LINE
····· STREAM
HSG B SOILS
HSG C SOILS

APPROVAL BLOCK

BLACKSBURG TOWN PLANNER

BLACKSBURG TOWN ENGINEER

60   0   60   120   180

SCALE: 1" = 60'

SHEET NO.
SW4

JOB NO. 24180058.00

SCALE: 1" = 30'

SW5

APPENDIX C:
STORMWATER MANAGEMENT CALCULATIONS

WATER QUANTITY

1S
DA #1

2S
AREA DRAINING TO
EX-1

1L
POA #1

2L
EX-1

3S
AREA BYPASSING
EX-1

3L
POA #2

Subcat   Reach   Pond   Link
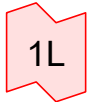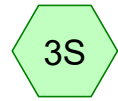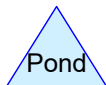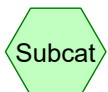
Routing Diagram for PRE DEV
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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1
Runoff Area=7.997 ac   Runoff Depth=0.97"
Flow Length=998'   Tc=58.8 min   CN=WQ   Runoff=3.67 cfs 0.648 af

Subcatchment 2S: AREA DRAINING TO EX-1
Runoff Area=2.238 ac   Runoff Depth=0.67"
Flow Length=285'   Tc=22.7 min   CN=WQ   Runoff=1.01 cfs 0.125 af

Subcatchment 3S: AREA BYPASSING EX-1
Runoff Area=7.104 ac   Runoff Depth=1.38"
Tc=6.0 min   CN=WQ   Runoff=13.72 cfs 0.814 af

Link 1L: POA #1
Inflow=3.67 cfs 0.648 af
Primary=3.67 cfs 0.648 af

Link 2L: EX-1
Inflow=1.01 cfs 0.125 af
Primary=1.01 cfs 0.125 af

Link 3L: POA #2
Inflow=14.06 cfs 0.939 af
Primary=14.06 cfs 0.939 af

Total Runoff Area = 17.339 ac   Runoff Volume = 1.587 af   Average Runoff Depth = 1.10"

Summary for Subcatchment 1S: DA #1

Runoff = 3.67 cfs @ 12.75 hrs, Volume= 0.648 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.451	61	>75% Grass cover, Good, HSG B
1.433	74	>75% Grass cover, Good, HSG C
0.923	55	Woods, Good, HSG B
0.285	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.104	98	Paved parking, HSG B
0.101	98	Paved parking, HSG C
7.997		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.6	150	0.0267	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
7.4	440	0.0398	1.00		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
58.8	998				Total

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Subcatchment 1S: DA #1

Hydrograph

Legend: ☐ Runoff

3.67 cfs

**VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=7.997 ac
Runoff Volume=0.648 af
Runoff Depth=0.97"
Flow Length=998'
Tc=58.8 min
CN=WQ**

Flow (cfs) — vertical axis

Time (hours) — horizontal axis

Summary for Subcatchment 2S: AREA DRAINING TO EX-1

Runoff   =   1.01 cfs @   12.29 hrs, Volume=   0.125 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
1.017	74	>75% Grass cover, Good, HSG C
0.005	55	Woods, Good, HSG B
0.872	70	Woods, Good, HSG C
0.285	98	Paved roads w/curbs & sewers, HSG C
0.059	98	Paved parking, HSG C
2.238		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	60	0.0333	0.05		**Sheet Flow, Tc4**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
0.9	225	0.0711	4.29		**Shallow Concentrated Flow, Tc5**
					Unpaved Kv= 16.1 fps
22.7	285				Total

Subcatchment 2S: AREA DRAINING TO EX-1

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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
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Summary for Subcatchment 3S: AREA BYPASSING EX-1

Runoff   =   13.72 cfs @   12.04 hrs, Volume=   0.814 af, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.076	55	Woods, Good, HSG B
0.287	70	Woods, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.881	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.356	98	Paved parking, HSG C
7.104		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: AREA BYPASSING EX-1

Hydrograph

VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=7.104 ac
Runoff Volume=0.814 af
Runoff Depth=1.38"
Tc=6.0 min
CN=WQ

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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
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Summary for Link 1L: POA #1

Inflow Area =   7.997 ac, Inflow Depth =   0.97"   for 1-yr event
Inflow   =   3.67 cfs @   12.75 hrs, Volume=   0.648 af
Primary   =   3.67 cfs @   12.75 hrs, Volume=   0.648 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1

Hydrograph

3.67 cfs
3.67 cfs

Inflow Area=7.997 ac

Inflow
Primary

Flow (cfs)

Time (hours)
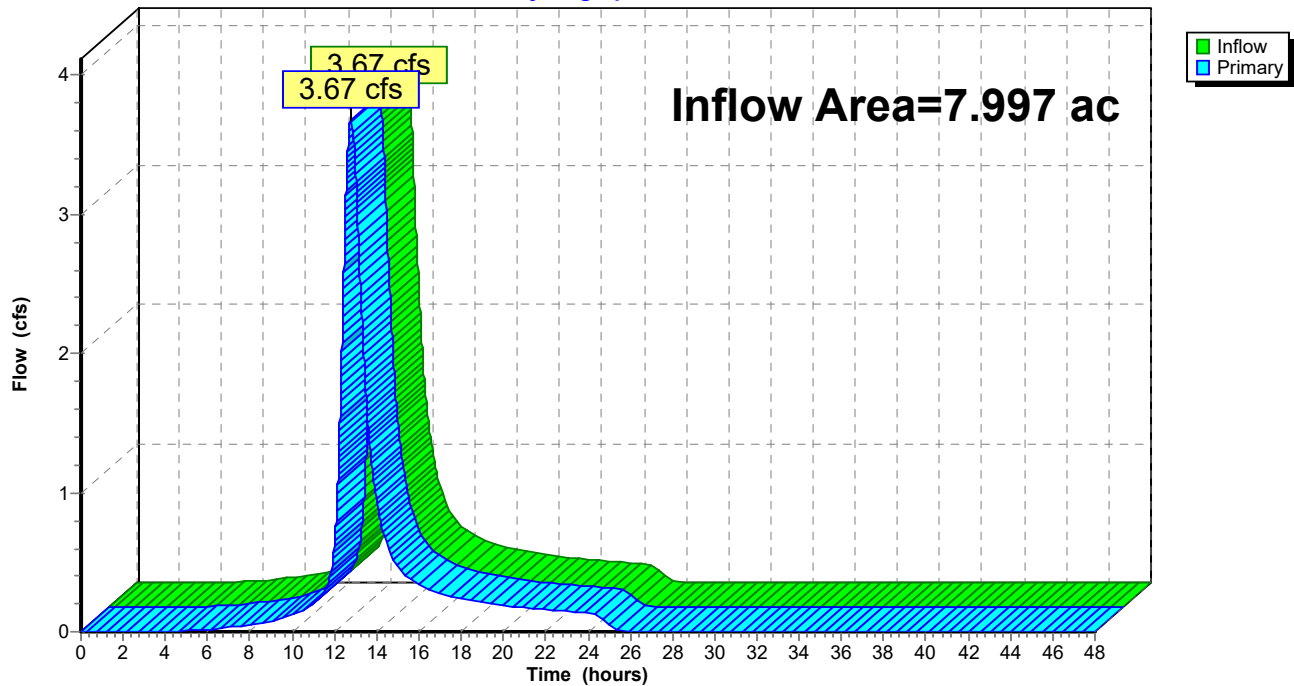
Summary for Link 2L: EX-1

Inflow Area = 2.238 ac, Inflow Depth = 0.67" for 1-yr event
Inflow = 1.01 cfs @ 12.29 hrs, Volume= 0.125 af
Primary = 1.01 cfs @ 12.29 hrs, Volume= 0.125 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: EX-1
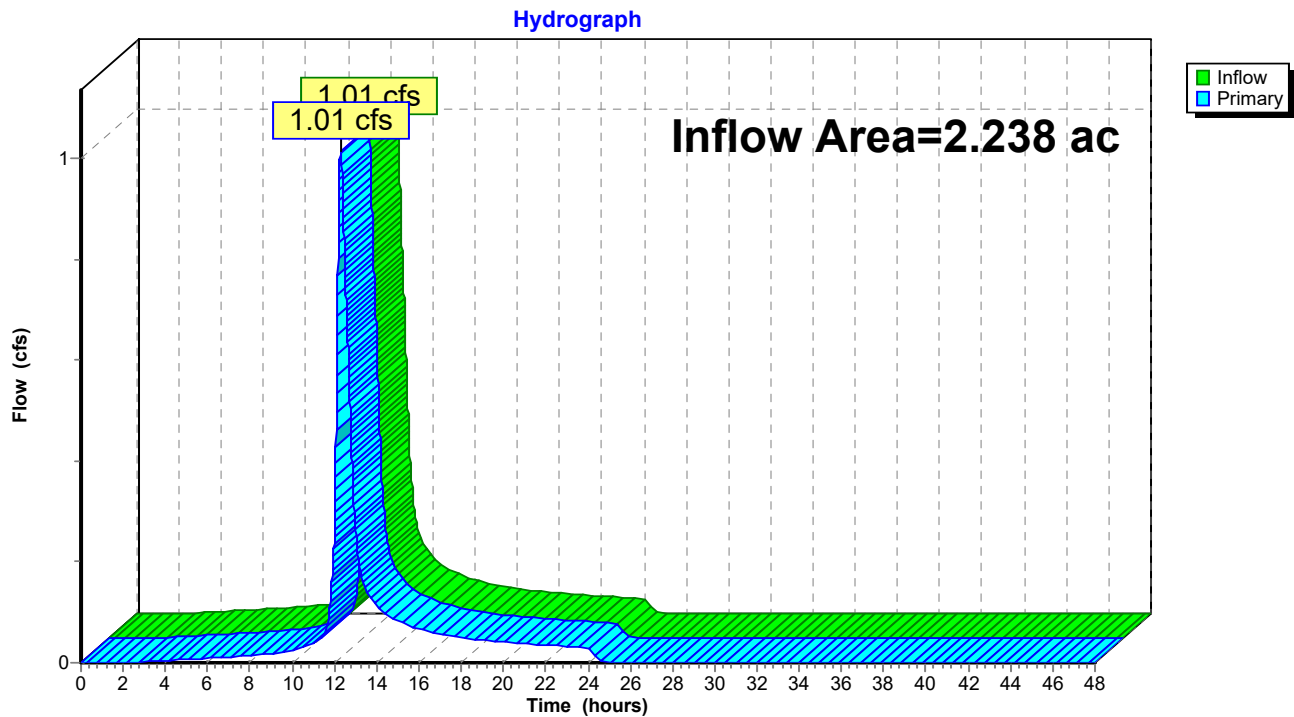
Summary for Link 3L: POA #2

Inflow Area =   9.342 ac, Inflow Depth = 1.21"   for 1-yr event
Inflow   =   14.06 cfs @ 12.04 hrs, Volume=   0.939 af
Primary   =   14.06 cfs @ 12.04 hrs, Volume=   0.939 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2

Hydrograph
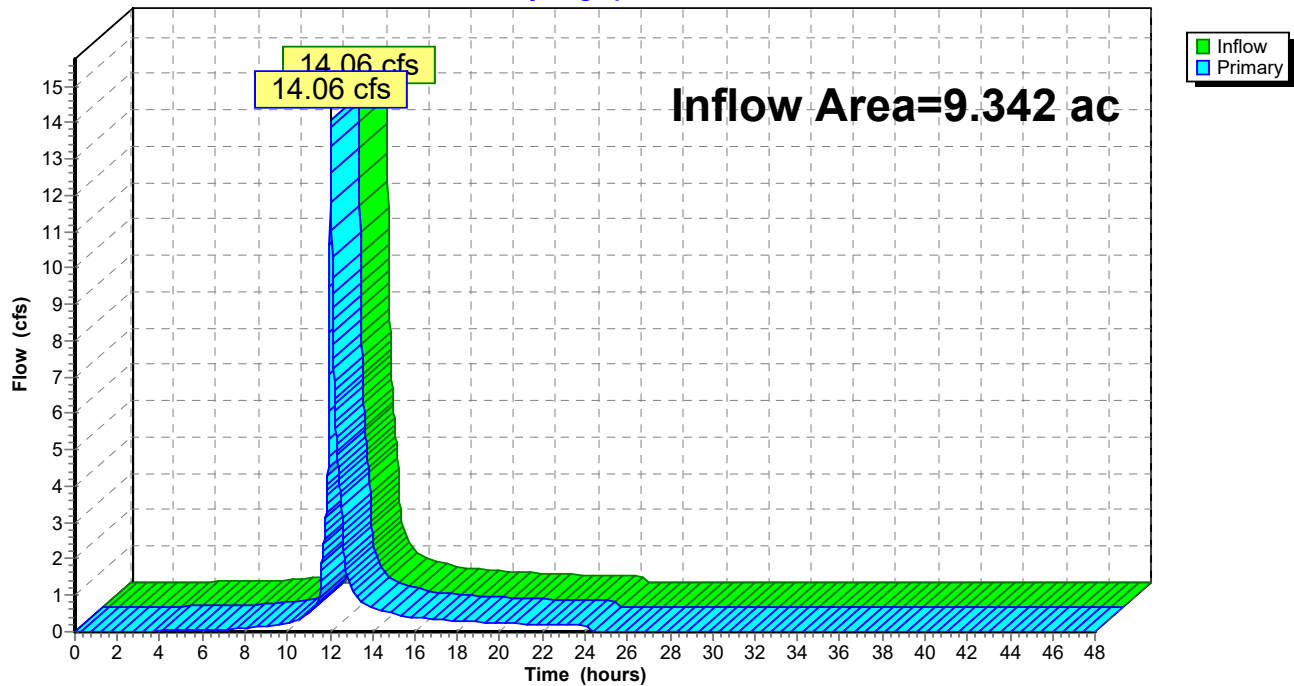
Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1   Runoff Area=7.997 ac   Runoff Depth=1.30"
Flow Length=998' Tc=58.8 min   CN=WQ   Runoff=4.96 cfs 0.870 af

Subcatchment 2S: AREA DRAINING TO EX-1   Runoff Area=2.238 ac   Runoff Depth=0.96"
Flow Length=285' Tc=22.7 min   CN=WQ   Runoff=1.55 cfs 0.178 af

Subcatchment 3S: AREA BYPASSING EX-1   Runoff Area=7.104 ac   Runoff Depth=1.79"
Tc=6.0 min   CN=WQ   Runoff=17.83 cfs 1.062 af

Link 1L: POA #1   Inflow=4.96 cfs 0.870 af
Primary=4.96 cfs 0.870 af

Link 2L: EX-1   Inflow=1.55 cfs 0.178 af
Primary=1.55 cfs 0.178 af

Link 3L: POA #2   Inflow=18.37 cfs 1.241 af
Primary=18.37 cfs 1.241 af

Total Runoff Area = 17.339 ac   Runoff Volume = 2.110 af   Average Runoff Depth = 1.46"

Summary for Subcatchment 1S: DA #1

Runoff   =   4.96 cfs @ 12.75 hrs, Volume=   0.870 af, Depth= 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.451	61	>75% Grass cover, Good, HSG B
1.433	74	>75% Grass cover, Good, HSG C
0.923	55	Woods, Good, HSG B
0.285	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.104	98	Paved parking, HSG B
0.101	98	Paved parking, HSG C
7.997		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.6	150	0.0267	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
7.4	440	0.0398	1.00		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
58.8	998	Total			

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VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"
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Subcatchment 1S: DA #1

Hydrograph

4.96 cfs

Runoff

**VA-BLACKSBURG NOAA 2-yr
Rainfall=2.75"
Runoff Area=7.997 ac
Runoff Volume=0.870 af
Runoff Depth=1.30"
Flow Length=998'
Tc=58.8 min
CN=WQ**

Summary for Subcatchment 2S: AREA DRAINING TO EX-1

Runoff   =   1.55 cfs @ 12.29 hrs, Volume=   0.178 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
1.017	74	>75% Grass cover, Good, HSG C
0.005	55	Woods, Good, HSG B
0.872	70	Woods, Good, HSG C
0.285	98	Paved roads w/curbs & sewers, HSG C
0.059	98	Paved parking, HSG C
2.238		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	60	0.0333	0.05		**Sheet Flow, Tc4**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
0.9	225	0.0711	4.29		**Shallow Concentrated Flow, Tc5**
					Unpaved Kv= 16.1 fps
22.7	285	Total			

Subcatchment 2S: AREA DRAINING TO EX-1

Hydrograph

VA-BLACKSBURG NOAA 2-yr
Rainfall=2.75"
Runoff Area=2.238 ac
Runoff Volume=0.178 af
Runoff Depth=0.96"
Flow Length=285'
Tc=22.7 min
CN=WQ

1.55 cfs

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VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"
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Summary for Subcatchment 3S: AREA BYPASSING EX-1

Runoff   =   17.83 cfs @ 12.04 hrs, Volume=   1.062 af, Depth= 1.79"
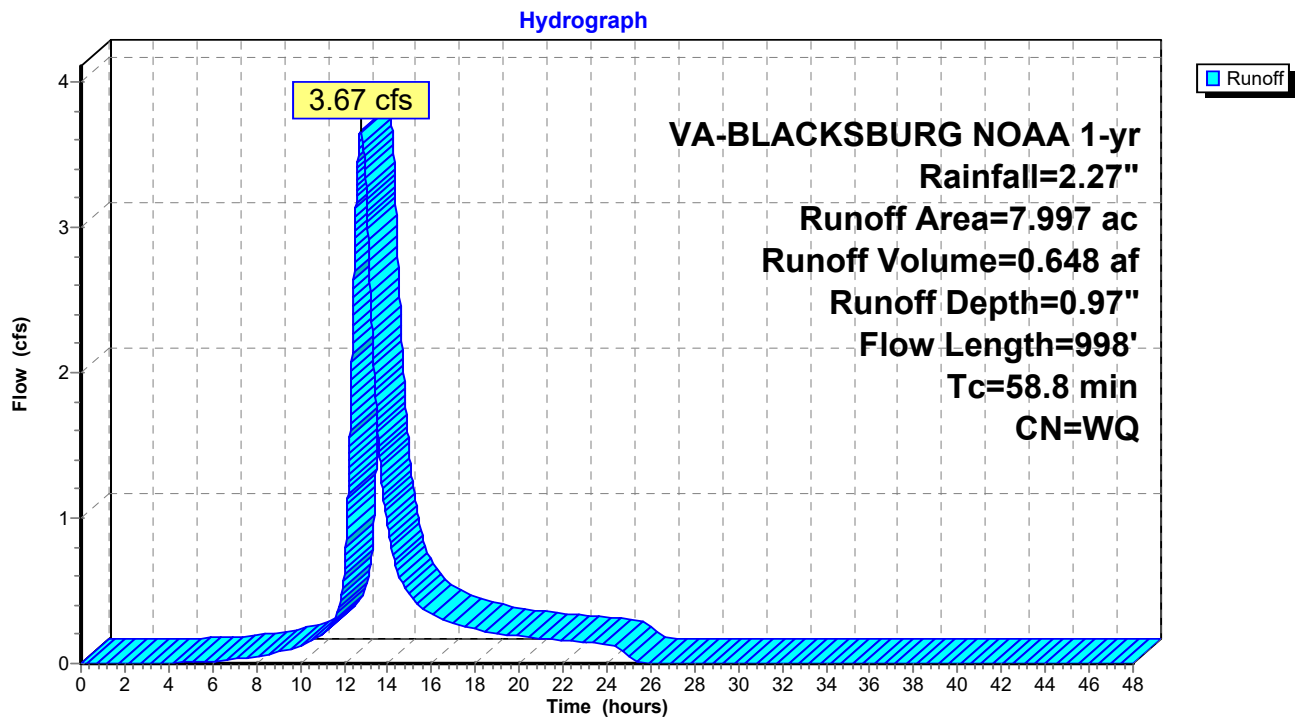
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.076	55	Woods, Good, HSG B
0.287	70	Woods, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.881	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.356	98	Paved parking, HSG C
7.104		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: AREA BYPASSING EX-1

Hydrograph

VA-BLACKSBURG NOAA 2-yr
Rainfall=2.75"
Runoff Area=7.104 ac
Runoff Volume=1.062 af
Runoff Depth=1.79"
Tc=6.0 min
CN=WQ

17.83 cfs

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VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"
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Summary for Link 1L: POA #1

Inflow Area =   7.997 ac, Inflow Depth =   1.30"   for 2-yr event
Inflow   =   4.96 cfs @   12.75 hrs, Volume=   0.870 af
Primary   =   4.96 cfs @   12.75 hrs, Volume=   0.870 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1

Hydrograph

Summary for Link 2L: EX-1

Inflow Area = 2.238 ac, Inflow Depth = 0.96" for 2-yr event
Inflow = 1.55 cfs @ 12.29 hrs, Volume= 0.178 af
Primary = 1.55 cfs @ 12.29 hrs, Volume= 0.178 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: EX-1

Summary for Link 3L: POA #2

Inflow Area =   9.342 ac, Inflow Depth =   1.59"   for 2-yr event
Inflow   =   18.37 cfs @   12.04 hrs, Volume=   1.241 af
Primary   =   18.37 cfs @   12.04 hrs, Volume=   1.241 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2

Hydrograph
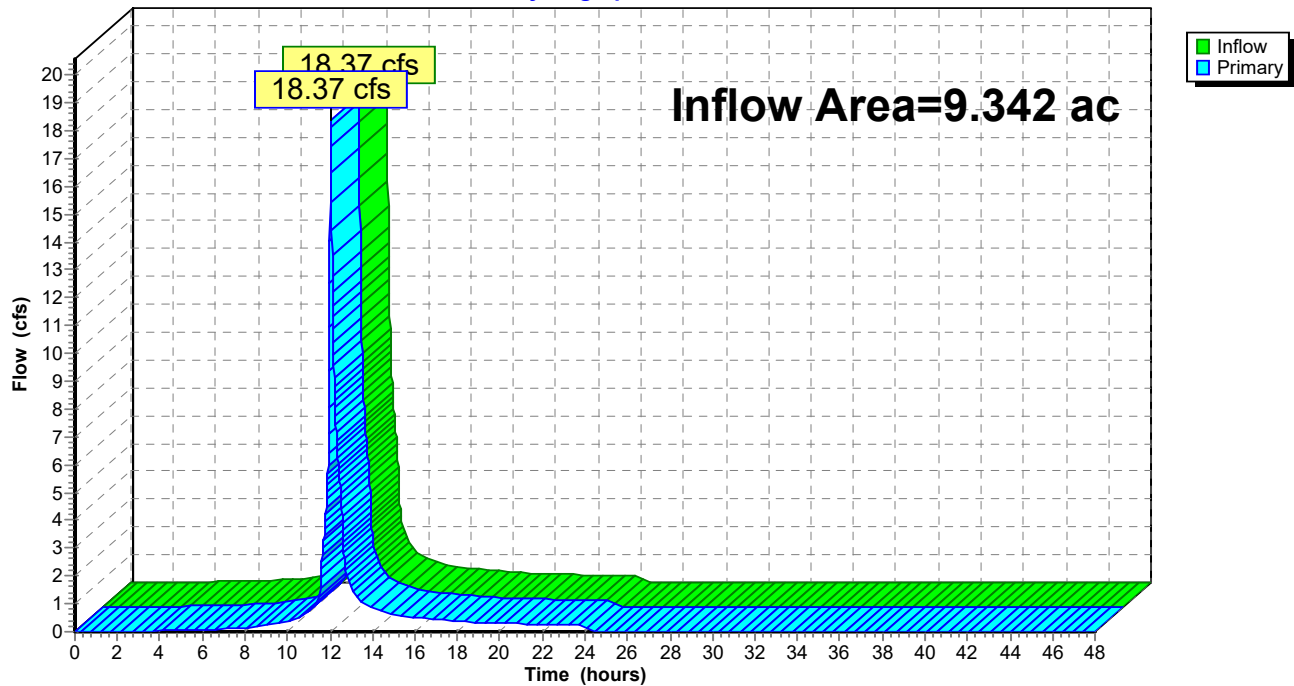
Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1   Runoff Area=7.997 ac   Runoff Depth=2.33"
                          Flow Length=998'   Tc=58.8 min   CN=WQ   Runoff=8.69 cfs 1.554 af

Subcatchment 2S: AREA DRAINING TO EX-1   Runoff Area=2.238 ac   Runoff Depth=1.89"
                          Flow Length=285'   Tc=22.7 min   CN=WQ   Runoff=3.13 cfs 0.353 af

Subcatchment 3S: AREA BYPASSING EX-1   Runoff Area=7.104 ac   Runoff Depth=3.02"
                          Tc=6.0 min   CN=WQ   Runoff=27.19 cfs 1.786 af

Link 1L: POA #1   Inflow=8.69 cfs 1.554 af
                                           Primary=8.69 cfs 1.554 af

Link 2L: EX-1   Inflow=3.13 cfs 0.353 af
                                           Primary=3.13 cfs 0.353 af

Link 3L: POA #2   Inflow=28.51 cfs 2.139 af
                                           Primary=28.51 cfs 2.139 af

Total Runoff Area = 17.339 ac   Runoff Volume = 3.693 af   Average Runoff Depth = 2.56"

Summary for Subcatchment 1S: DA #1

Runoff   =   8.69 cfs @ 12.74 hrs, Volume=   1.554 af, Depth= 2.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.451	61	>75% Grass cover, Good, HSG B
1.433	74	>75% Grass cover, Good, HSG C
0.923	55	Woods, Good, HSG B
0.285	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.104	98	Paved parking, HSG B
0.101	98	Paved parking, HSG C
7.997		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.6	150	0.0267	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
7.4	440	0.0398	1.00		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
58.8	998				Total

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VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"
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Page 20

Subcatchment 1S: DA #1

Hydrograph

Legend: ☐ Runoff

VA-BLACKSBURG NOAA 10-yr
Rainfall=4.09"
Runoff Area=7.997 ac
Runoff Volume=1.554 af
Runoff Depth=2.33"
Flow Length=998'
Tc=58.8 min
CN=WQ

Peak: 8.69 cfs

X-axis: Time (hours), 0 to 48
Y-axis: Flow (cfs), 0 to 9

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VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"
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Summary for Subcatchment 2S: AREA DRAINING TO EX-1

Runoff   =   3.13 cfs @ 12.28 hrs, Volume=   0.353 af, Depth= 1.89"
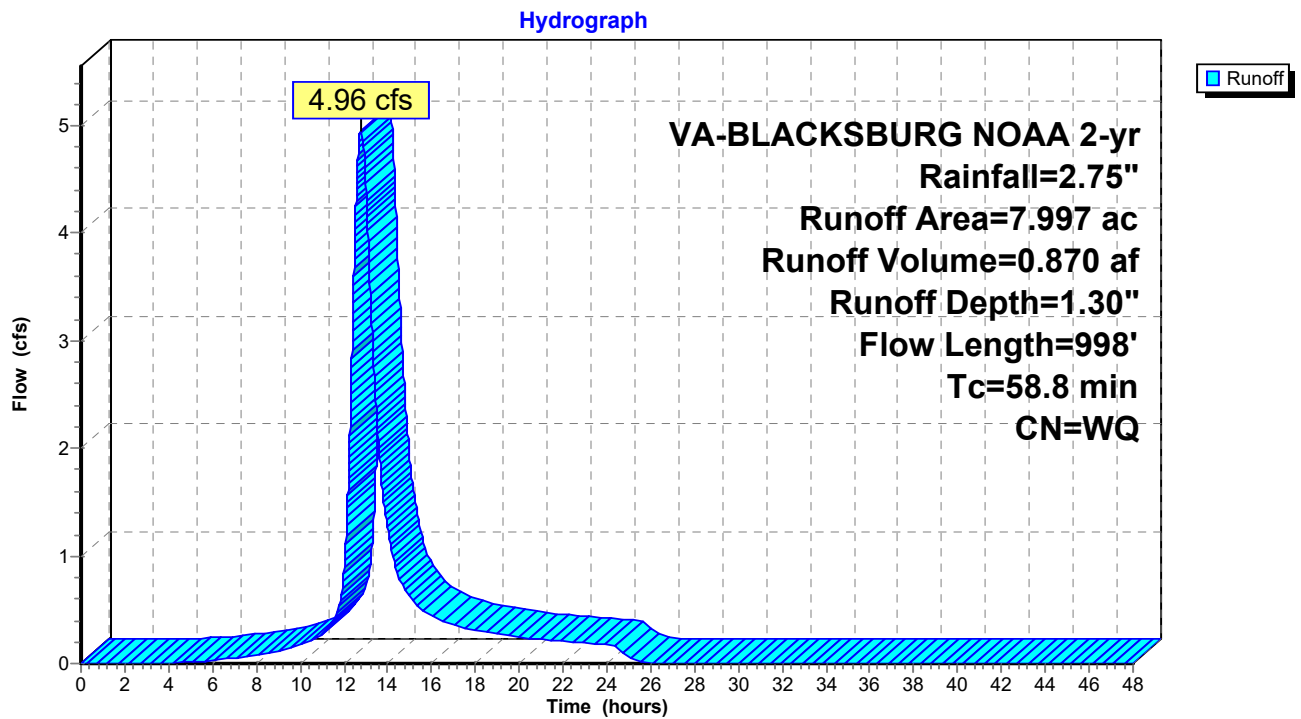
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
1.017	74	>75% Grass cover, Good, HSG C
0.005	55	Woods, Good, HSG B
0.872	70	Woods, Good, HSG C
0.285	98	Paved roads w/curbs & sewers, HSG C
0.059	98	Paved parking, HSG C
2.238		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	60	0.0333	0.05		**Sheet Flow, Tc4**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
0.9	225	0.0711	4.29		**Shallow Concentrated Flow, Tc5**
					Unpaved Kv= 16.1 fps
22.7	285				Total

Subcatchment 2S: AREA DRAINING TO EX-1

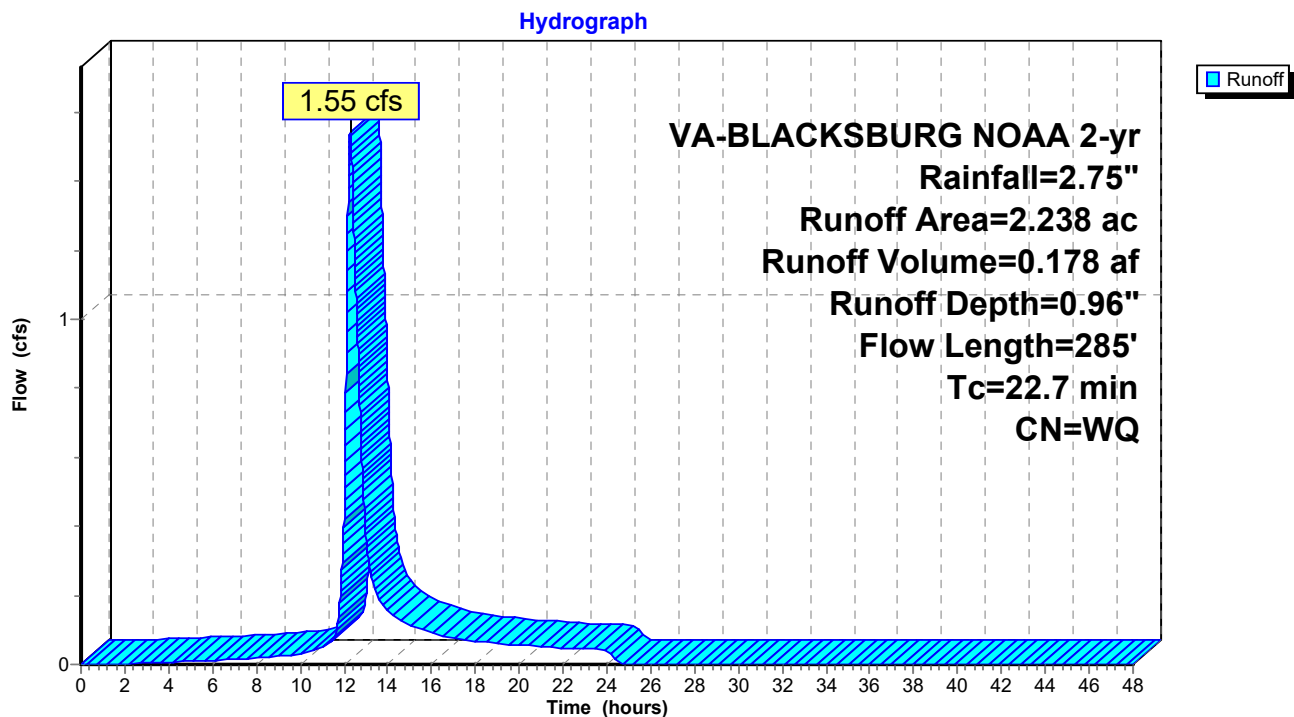## Summary for Subcatchment 3S: AREA BYPASSING EX-1

Runoff   =   27.19 cfs @ 12.04 hrs, Volume=   1.786 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.076	55	Woods, Good, HSG B
0.287	70	Woods, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.881	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.356	98	Paved parking, HSG C
7.104		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: AREA BYPASSING EX-1

Hydrograph

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VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"
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Page 23

Summary for Link 1L: POA #1

Inflow Area =   7.997 ac, Inflow Depth =   2.33"   for 10-yr event
Inflow   =   8.69 cfs @   12.74 hrs, Volume=   1.554 af
Primary   =   8.69 cfs @   12.74 hrs, Volume=   1.554 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1

Hydrograph

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VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"
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Page 24

Summary for Link 2L: EX-1

Inflow Area =   2.238 ac, Inflow Depth =   1.89"   for 10-yr event
Inflow   =   3.13 cfs @   12.28 hrs, Volume=   0.353 af
Primary   =   3.13 cfs @   12.28 hrs, Volume=   0.353 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: EX-1

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VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"
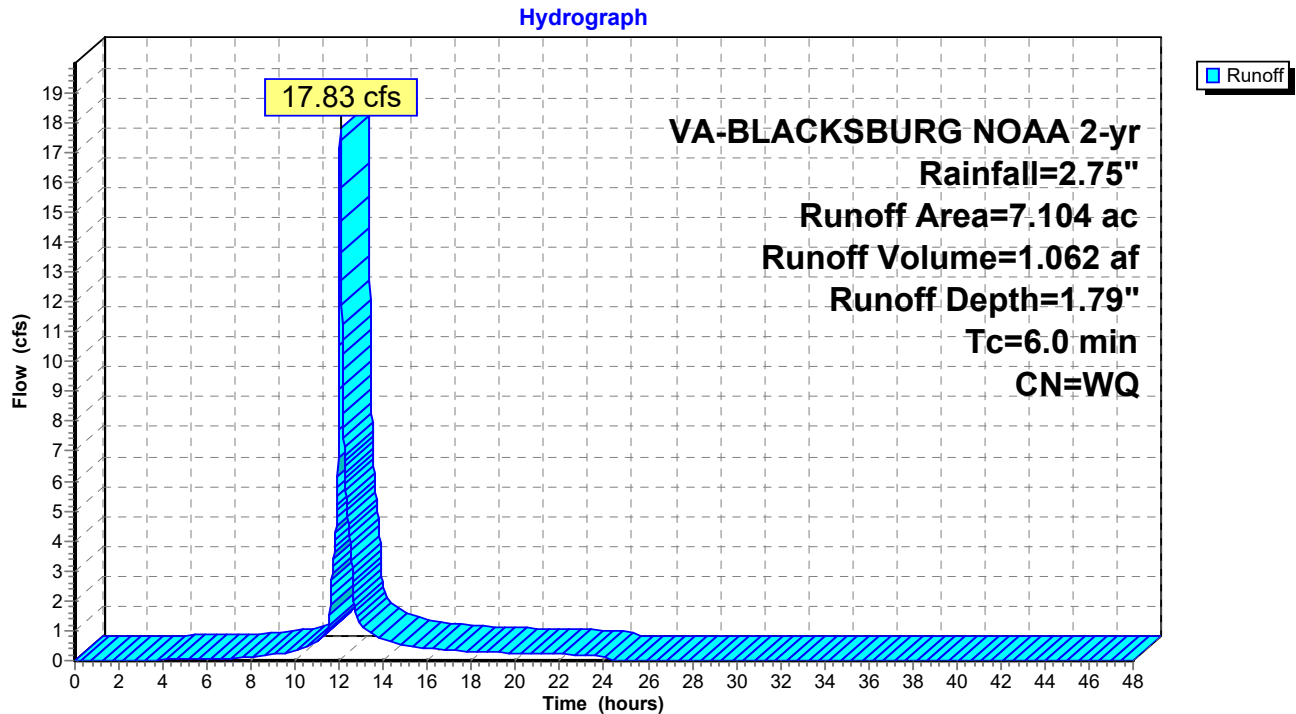Printed 8/1/2018
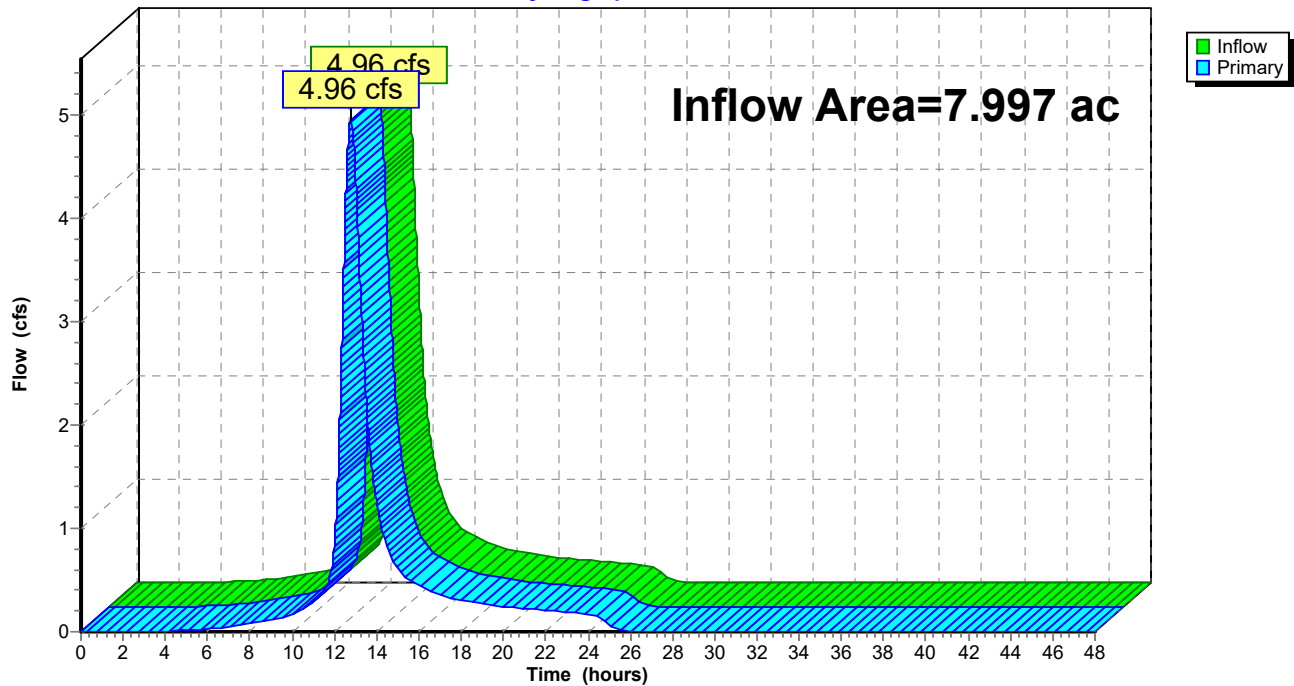Page 25

Summary for Link 3L: POA #2

Inflow Area =   9.342 ac, Inflow Depth =   2.75"   for 10-yr event
Inflow   =   28.51 cfs @   12.04 hrs, Volume=   2.139 af
Primary   =   28.51 cfs @   12.04 hrs, Volume=   2.139 af, Atten= 0%, Lag= 0.0 min

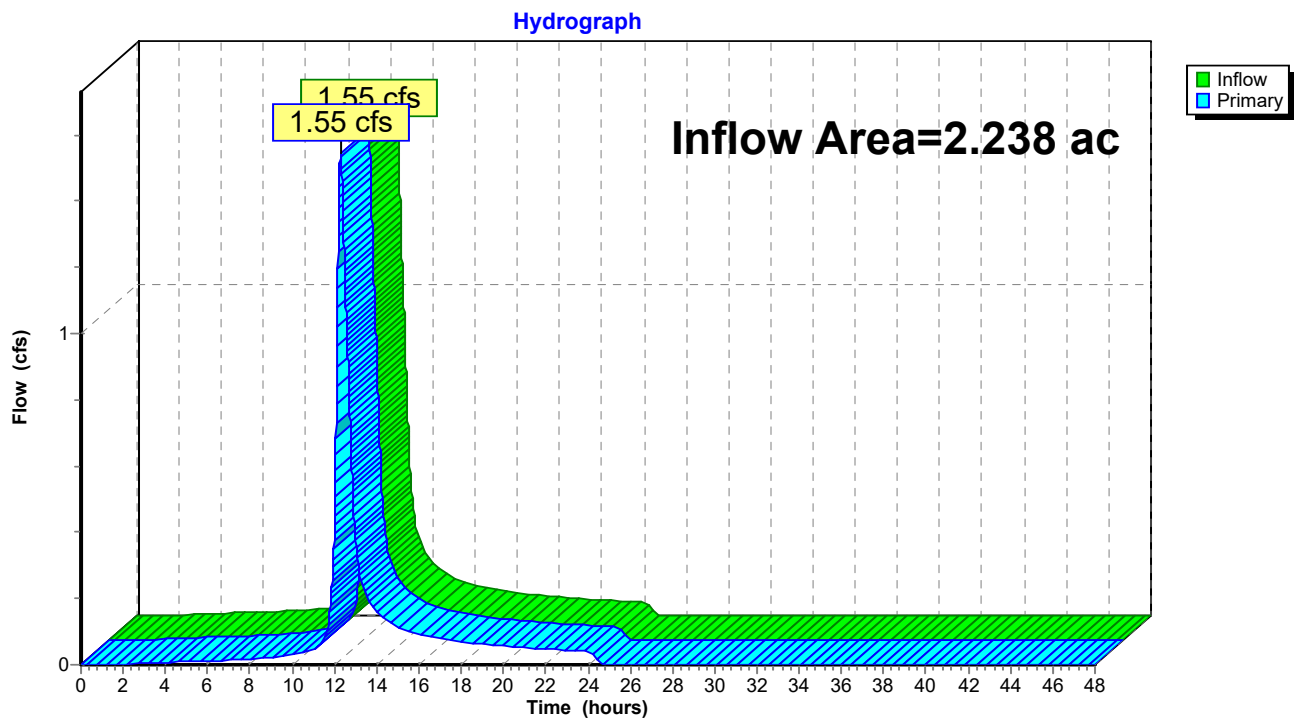Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2
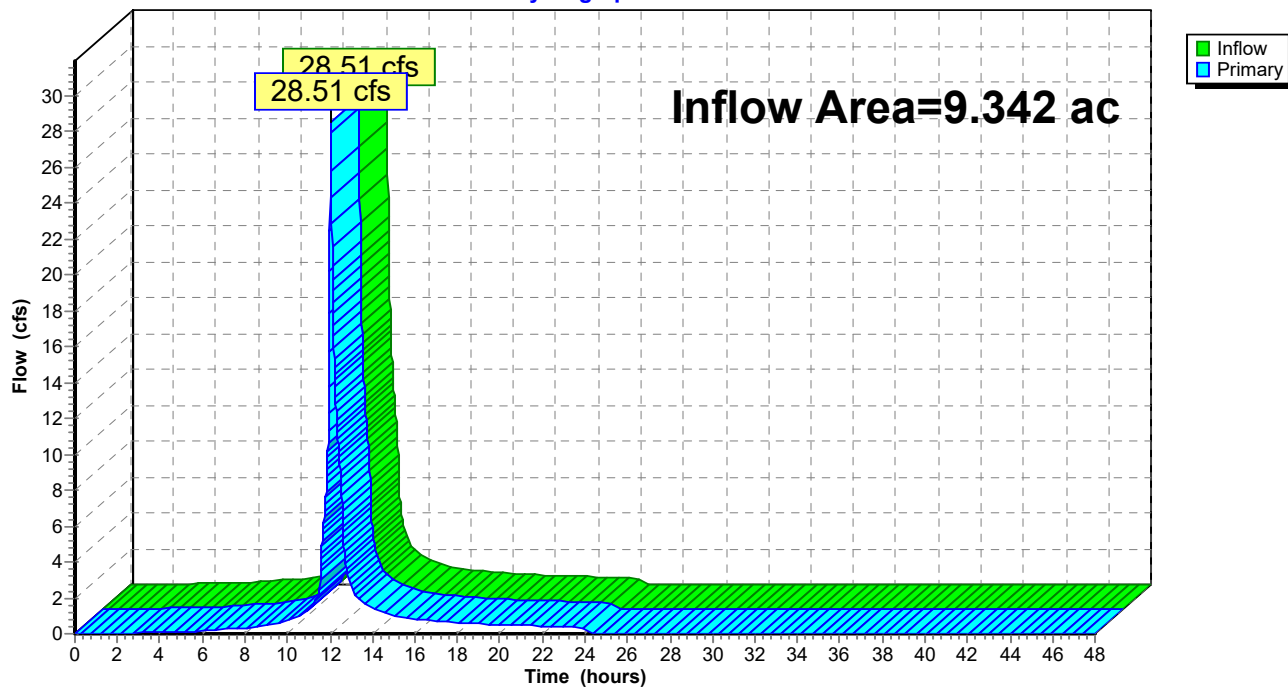
Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1 Runoff Area=7.997 ac Runoff Depth=4.36"
Flow Length=998' Tc=58.8 min CN=WQ Runoff=14.90 cfs 2.908 af

Subcatchment 2S: AREA DRAINING TO EX-1 Runoff Area=2.238 ac Runoff Depth=3.84"
Flow Length=285' Tc=22.7 min CN=WQ Runoff=5.80 cfs 0.716 af

Subcatchment 3S: AREA BYPASSING EX-1 Runoff Area=7.104 ac Runoff Depth=5.29"
Tc=6.0 min CN=WQ Runoff=39.62 cfs 3.132 af

Link 1L: POA #1 Inflow=14.90 cfs 2.908 af
Primary=14.90 cfs 2.908 af

Link 2L: EX-1 Inflow=5.80 cfs 0.716 af
Primary=5.80 cfs 0.716 af

Link 3L: POA #2 Inflow=42.49 cfs 3.848 af
Primary=42.49 cfs 3.848 af

Total Runoff Area = 17.339 ac Runoff Volume = 6.757 af Average Runoff Depth = 4.68"

Summary for Subcatchment 1S: DA #1

Runoff   =   14.90 cfs @ 12.74 hrs, Volume=   2.908 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.451	61	>75% Grass cover, Good, HSG B
1.433	74	>75% Grass cover, Good, HSG C
0.923	55	Woods, Good, HSG B
0.285	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.104	98	Paved parking, HSG B
0.101	98	Paved parking, HSG C
7.997		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.6	150	0.0267	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
7.4	440	0.0398	1.00		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
58.8	998				Total

Subcatchment 1S: DA #1

Hydrograph

VA-BLACKSBURG NOAA 100-yr
Rainfall=6.48"
Runoff Area=7.997 ac
Runoff Volume=2.908 af
Runoff Depth=4.36"
Flow Length=998'
Tc=58.8 min
CN=WQ

Peak: 14.90 cfs

Summary for Subcatchment 2S: AREA DRAINING TO EX-1

Runoff   =   5.80 cfs @   12.28 hrs, Volume=   0.716 af, Depth= 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
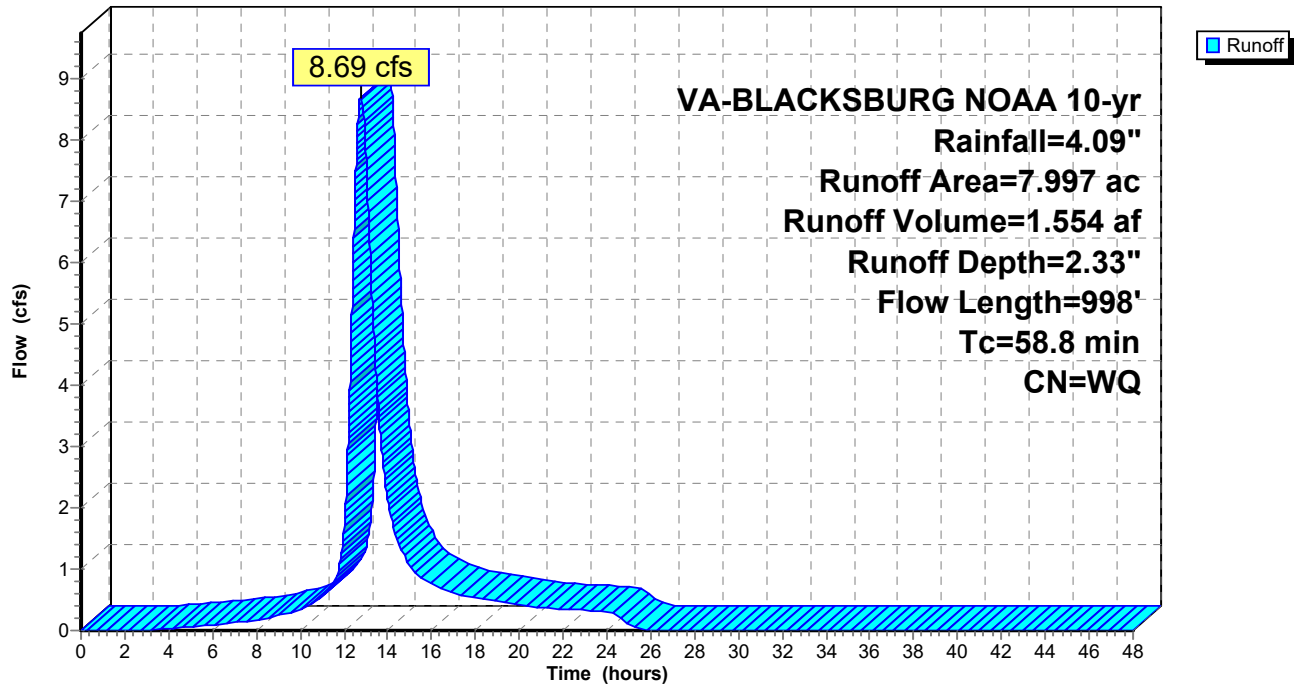VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
1.017	74	>75% Grass cover, Good, HSG C
0.005	55	Woods, Good, HSG B
0.872	70	Woods, Good, HSG C
0.285	98	Paved roads w/curbs & sewers, HSG C
0.059	98	Paved parking, HSG C
2.238		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	60	0.0333	0.05		**Sheet Flow, Tc4**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
0.9	225	0.0711	4.29		**Shallow Concentrated Flow, Tc5**
					Unpaved Kv= 16.1 fps
22.7	285	Total			

Subcatchment 2S: AREA DRAINING TO EX-1

Hydrograph

VA-BLACKSBURG NOAA 100-yr
Rainfall=6.48"
Runoff Area=2.238 ac
Runoff Volume=0.716 af
Runoff Depth=3.84"
Flow Length=285'
Tc=22.7 min
CN=WQ

5.80 cfs

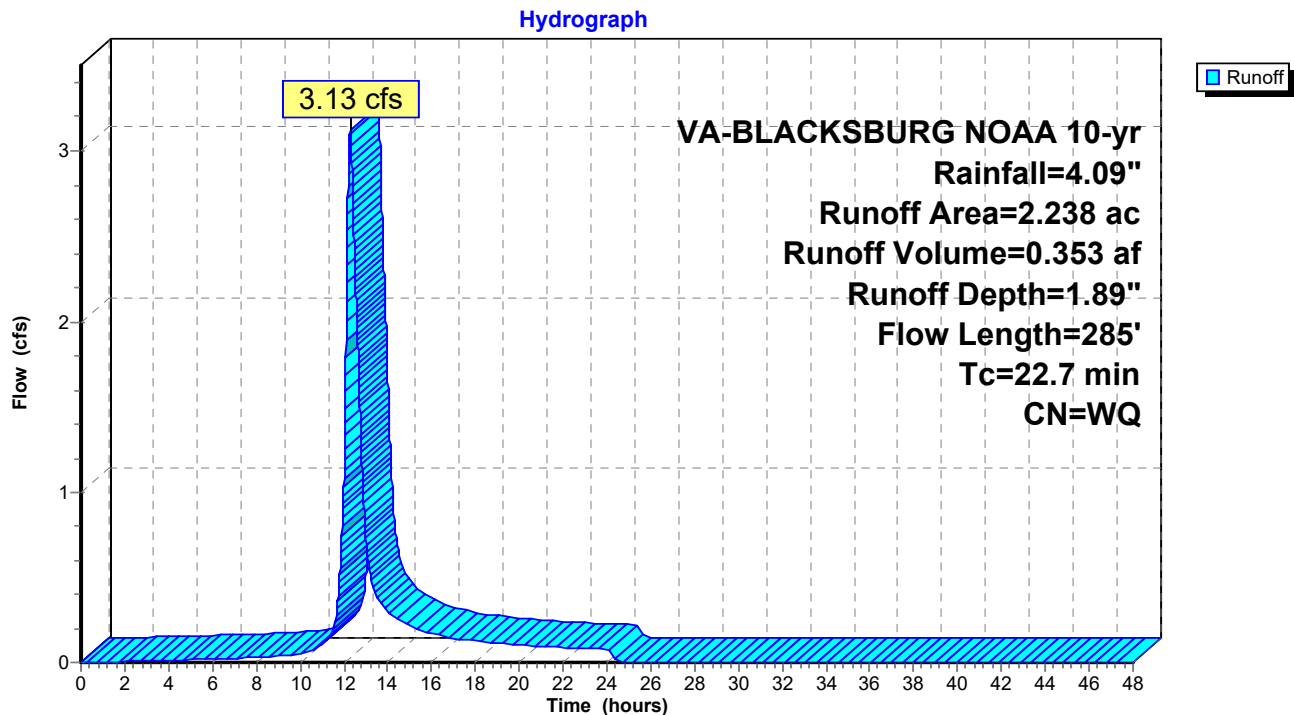## Summary for Subcatchment 3S: AREA BYPASSING EX-1

Runoff   =   39.62 cfs @ 12.04 hrs, Volume=   3.132 af, Depth= 5.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.076	55	Woods, Good, HSG B
0.287	70	Woods, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.881	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.356	98	Paved parking, HSG C
7.104		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: AREA BYPASSING EX-1

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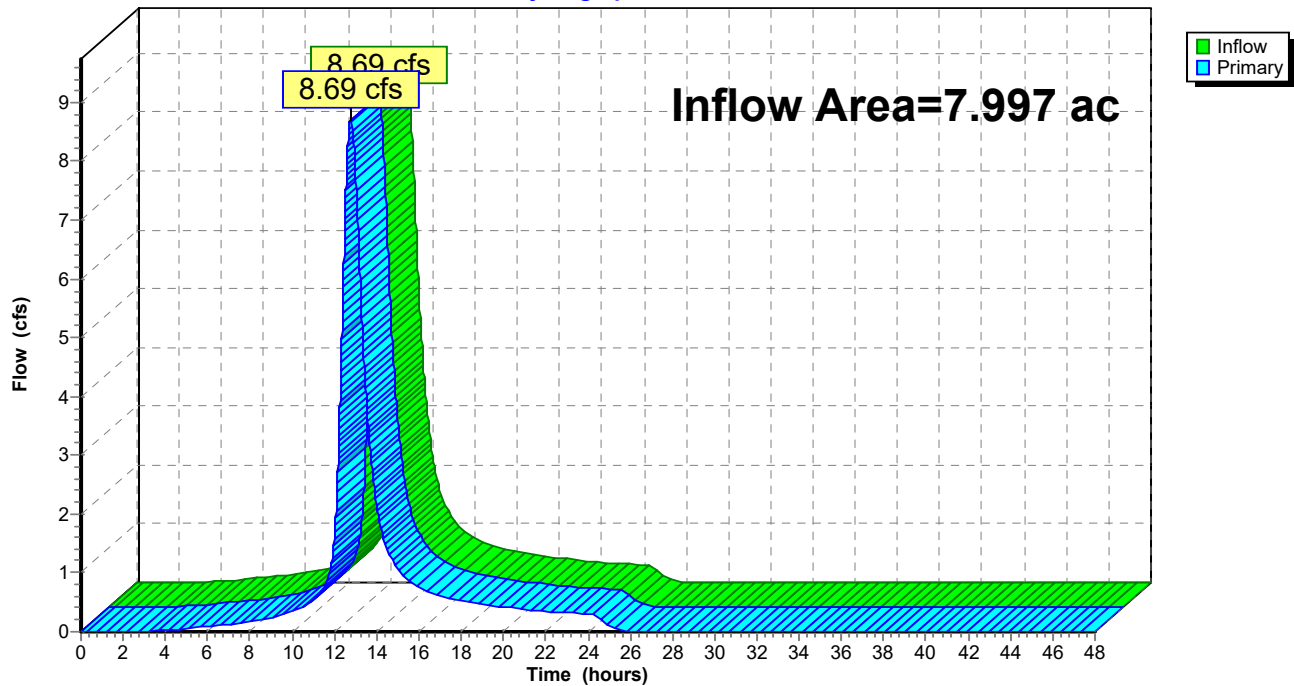Page 31

Summary for Link 1L: POA #1

Inflow Area =   7.997 ac, Inflow Depth = 4.36"   for 100-yr event
Inflow   =   14.90 cfs @   12.74 hrs, Volume=   2.908 af
Primary   =   14.90 cfs @   12.74 hrs, Volume=   2.908 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1

Hydrograph

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VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"
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Page 32
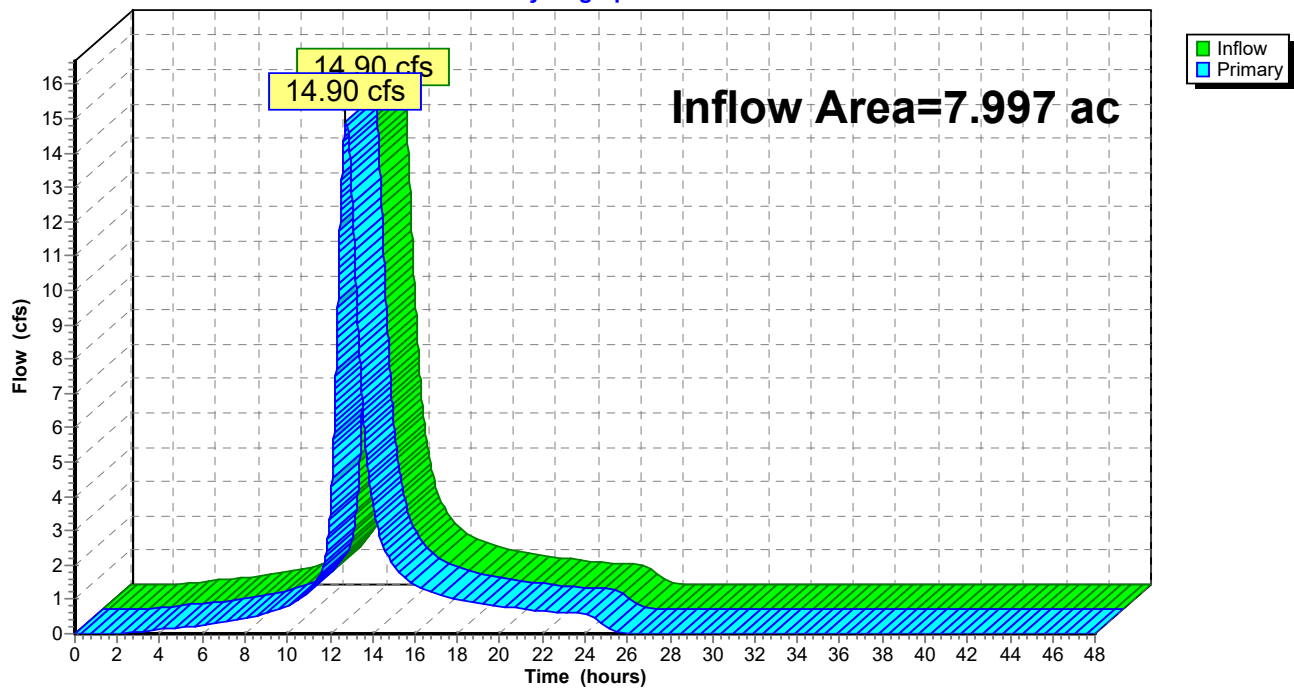
Summary for Link 2L: EX-1

Inflow Area =   2.238 ac, Inflow Depth =   3.84"   for 100-yr event
Inflow   =   5.80 cfs @   12.28 hrs, Volume=   0.716 af
Primary   =   5.80 cfs @   12.28 hrs, Volume=   0.716 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: EX-1

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VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"
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Page 33
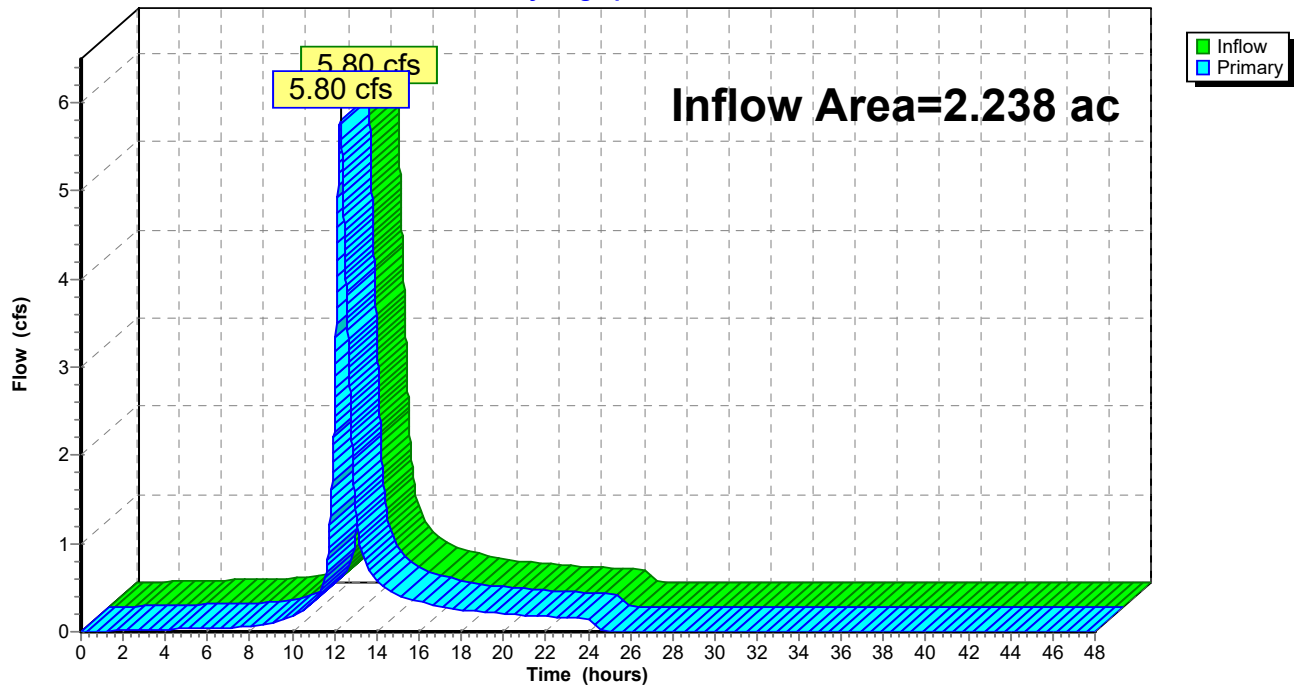
Summary for Link 3L: POA #2

Inflow Area =   9.342 ac, Inflow Depth = 4.94"   for 100-yr event
Inflow   =   42.49 cfs @   12.04 hrs, Volume=   3.848 af
Primary   =   42.49 cfs @   12.04 hrs, Volume=   3.848 af, Atten= 0%, Lag= 0.0 min

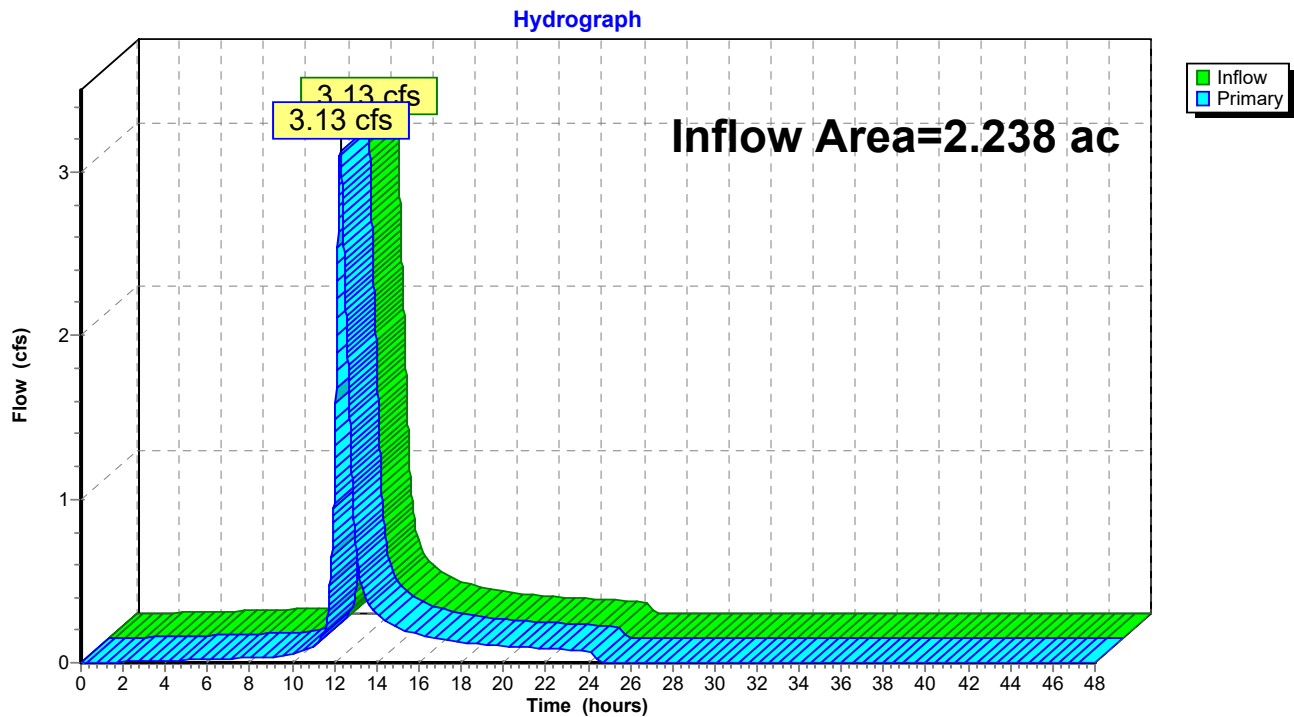Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2

3S

DA TO DETENTION
SYSTEM #2

2S

DA TO DETENTION
SYSTEM #1

2P

UNDERGROUND
DETENTION SYSTEM
#2

1P

UNDERGROUND
DETENTION SYSTEM
#1

1S

BYPASS AREA

2L

MH-A

1L

POA #1

3L

POA #2

5S

BYPASS AREA
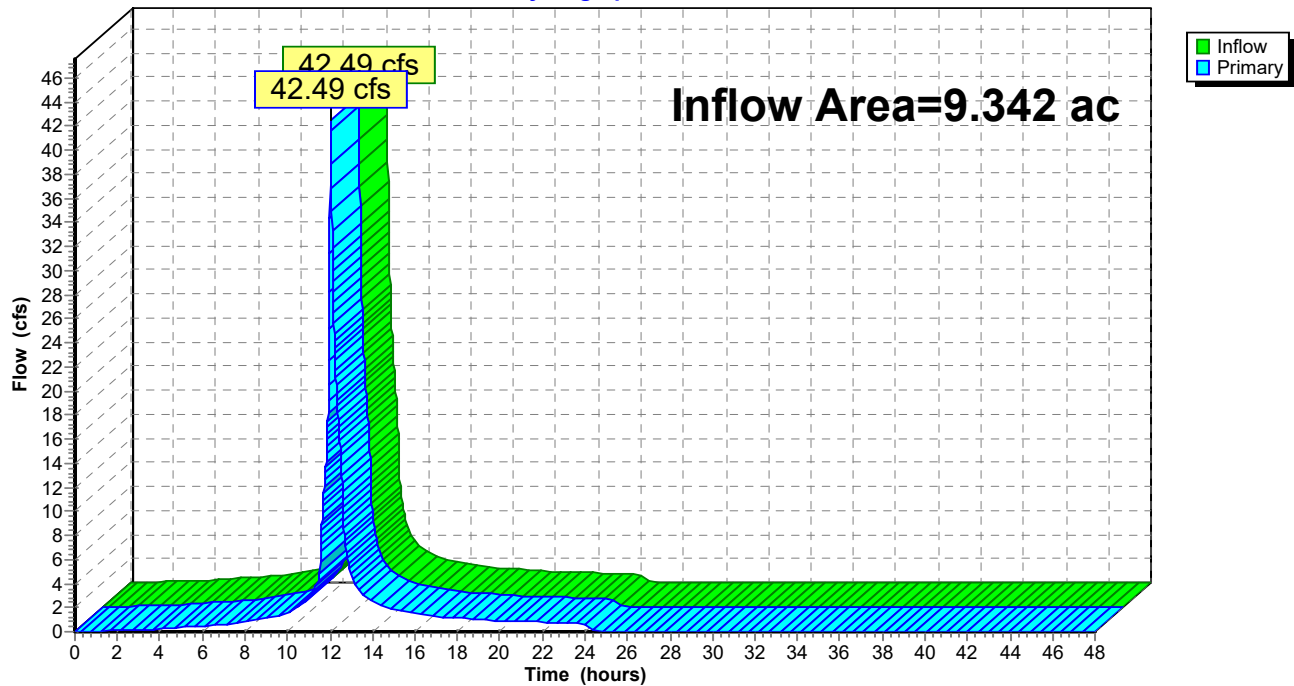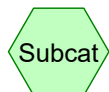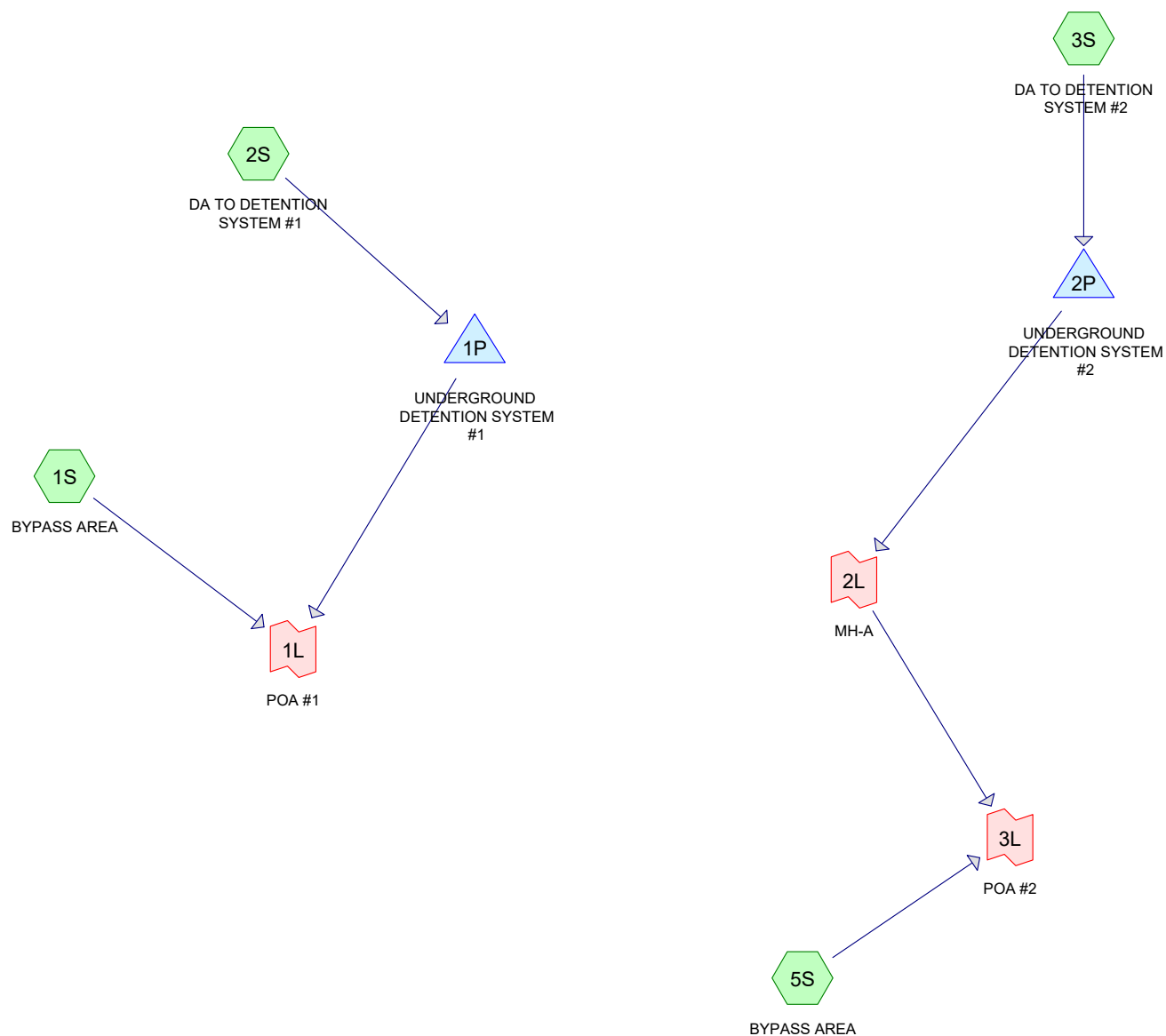
Subcat   Reach   Pond   Link
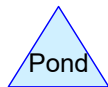
Routing Diagram for POST DEV
Prepared by Balzer & Associates, Inc., Printed 8/1/2018
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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: BYPASS AREA   Runoff Area=6.010 ac   Runoff Depth=1.17"
                    Flow Length=973'   Tc=60.9 min   CN=WQ   Runoff=3.32 cfs 0.584 af

Subcatchment 2S: DA TO DETENTION SYSTEM #1   Runoff Area=2.266 ac   Runoff Depth=1.62"
                    Tc=6.0 min   CN=WQ   Runoff=4.82 cfs 0.306 af

Subcatchment 3S: DA TO DETENTION SYSTEM #2   Runoff Area=2.268 ac   Runoff Depth=1.44"
                    Tc=6.0 min   CN=WQ   Runoff=4.28 cfs 0.273 af

Subcatchment 5S: BYPASS AREA   Runoff Area=6.766 ac   Runoff Depth=1.44"
                    Tc=6.0 min   CN=WQ   Runoff=13.70 cfs 0.810 af

Pond 1P: UNDERGROUND DETENTION   Peak Elev=2,159.90' Storage=0.210 af   Inflow=4.82 cfs 0.306 af
                    Outflow=0.13 cfs 0.228 af

Pond 2P: UNDERGROUND DETENTION   Peak Elev=2,157.10' Storage=0.158 af   Inflow=4.28 cfs 0.273 af
                    Outflow=0.12 cfs 0.273 af

Link 1L: POA #1   Inflow=3.39 cfs 0.812 af
                                          Primary=3.39 cfs 0.812 af

Link 2L: MH-A   Inflow=0.12 cfs 0.273 af
                                          Primary=0.12 cfs 0.273 af

Link 3L: POA #2   Inflow=13.79 cfs 1.083 af
                                          Primary=13.79 cfs 1.083 af

Total Runoff Area = 17.310 ac   Runoff Volume = 1.973 af   Average Runoff Depth = 1.37"

Summary for Subcatchment 1S: BYPASS AREA

Runoff   =   3.32 cfs @ 12.79 hrs, Volume=   0.584 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
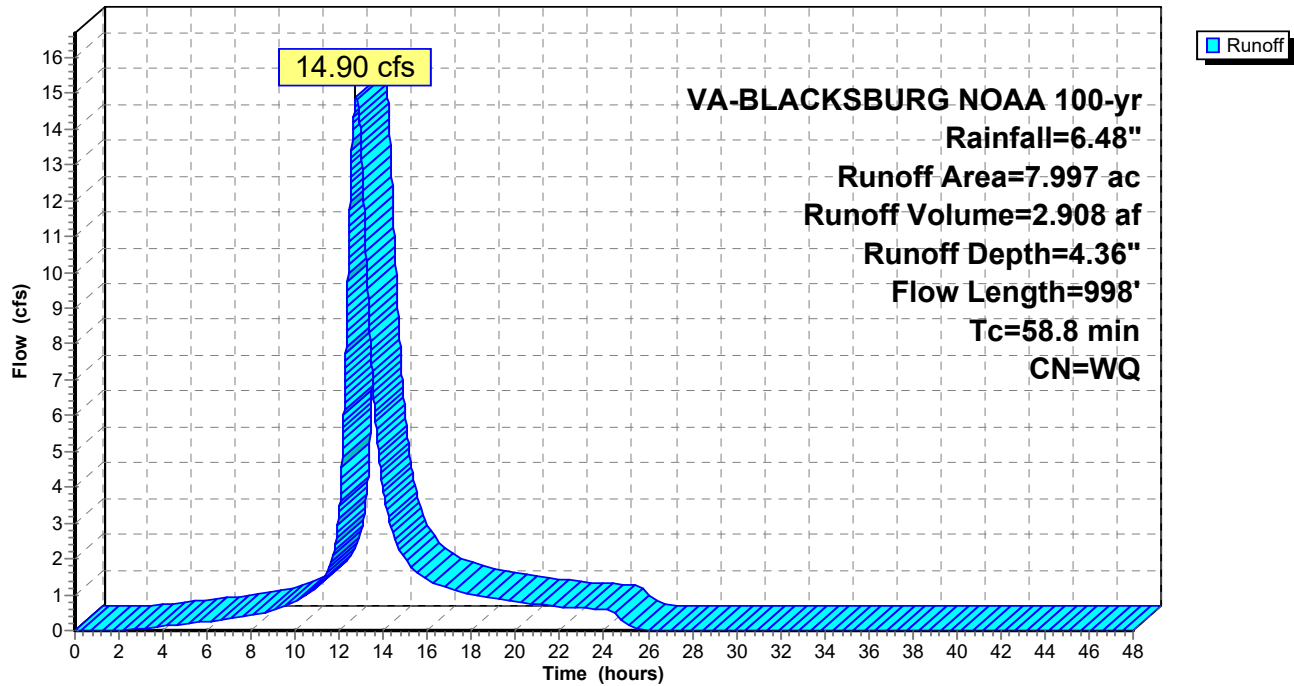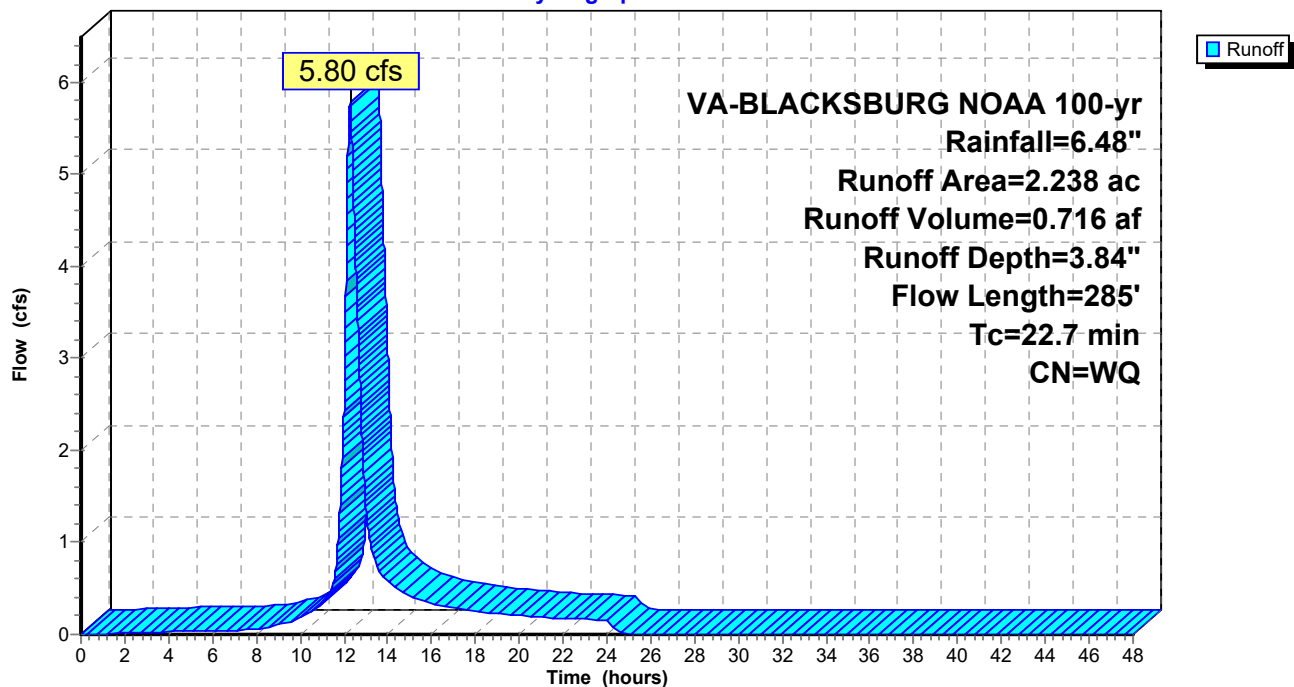VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.433	61	>75% Grass cover, Good, HSG B
0.407	74	>75% Grass cover, Good, HSG C
0.270	55	Woods, Good, HSG B
0.076	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.068	98	Paved parking, HSG B
0.056	98	Paved parking, HSG C
6.010		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.4	150	0.0233	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
6.7	415	0.0422	1.03		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
60.9	973	Total			

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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
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Subcatchment 1S: BYPASS AREA

Hydrograph

☐ Runoff

3.32 cfs

VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=6.010 ac
Runoff Volume=0.584 af
Runoff Depth=1.17"
Flow Length=973'
Tc=60.9 min
CN=WQ

Flow (cfs)

Time (hours)

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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
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Summary for Subcatchment 2S: DA TO DETENTION SYSTEM #1

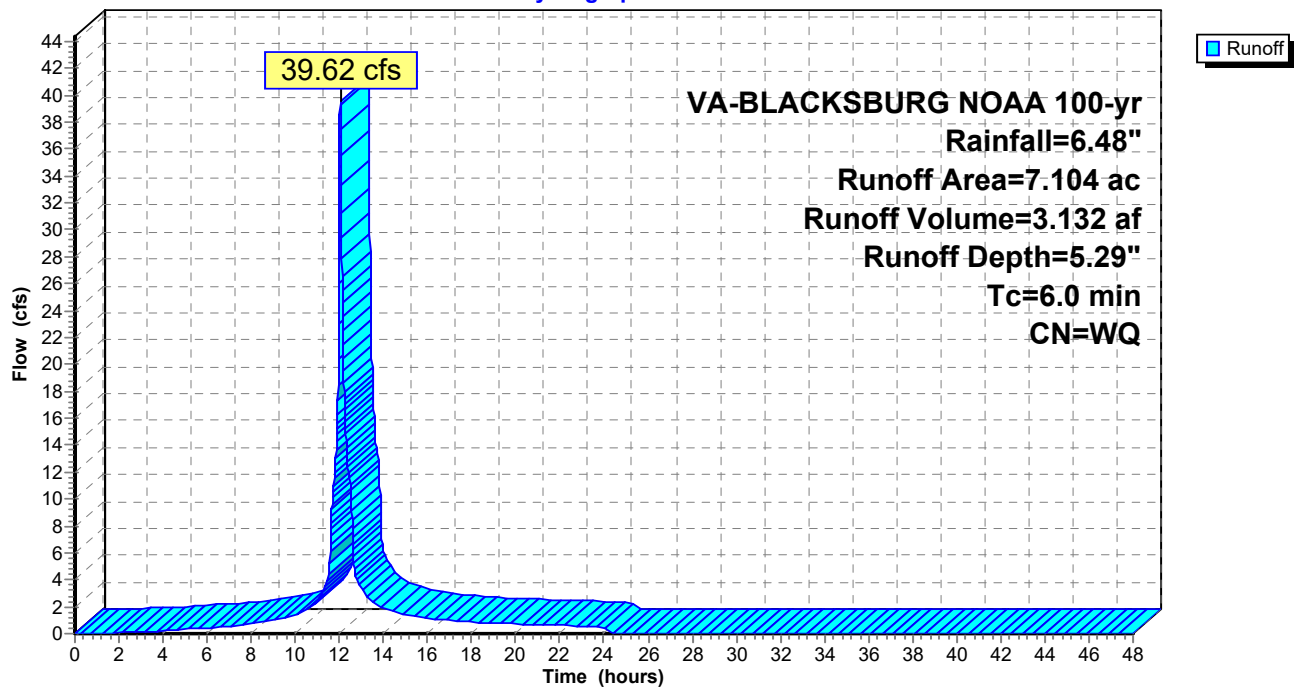Runoff   =   4.82 cfs @   12.04 hrs, Volume=   0.306 af, Depth= 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.176	61	>75% Grass cover, Good, HSG B
0.401	74	>75% Grass cover, Good, HSG C
0.339	98	Paved parking, HSG B
1.350	98	Paved parking, HSG C
2.266		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 2S: DA TO DETENTION SYSTEM #1

Hydrograph

4.82 cfs

VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=2.266 ac
Runoff Volume=0.306 af
Runoff Depth=1.62"
Tc=6.0 min
CN=WQ

□ Runoff

Summary for Subcatchment 3S: DA TO DETENTION SYSTEM #2

Runoff   =   4.28 cfs @ 12.04 hrs, Volume=   0.273 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.071	61	>75% Grass cover, Good, HSG B
0.621	74	>75% Grass cover, Good, HSG C
0.064	55	Woods, Good, HSG B
0.074	70	Woods, Good, HSG C
0.135	98	Paved roads w/curbs & sewers, HSG C
0.131	98	Paved parking, HSG B
1.172	98	Paved parking, HSG C
2.268		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: DA TO DETENTION SYSTEM #2

**VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=2.268 ac
Runoff Volume=0.273 af
Runoff Depth=1.44"
Tc=6.0 min
CN=WQ**

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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
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Summary for Subcatchment 5S: BYPASS AREA

Runoff   =   13.70 cfs @ 12.04 hrs, Volume=   0.810 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.878	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.384	98	Paved roads w/curbs & sewers, HSG C
6.766		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 5S: BYPASS AREA

Hydrograph

VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=6.766 ac
Runoff Volume=0.810 af
Runoff Depth=1.44"
Tc=6.0 min
CN=WQ

13.70 cfs

Summary for Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Inflow Area =   2.266 ac, Inflow Depth =   1.62"   for 1-yr event
Inflow   =   4.82 cfs @ 12.04 hrs, Volume=   0.306 af
Outflow   =   0.13 cfs @ 15.00 hrs, Volume=   0.228 af, Atten= 97%, Lag= 178.0 min
Primary   =   0.13 cfs @ 15.00 hrs, Volume=   0.228 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,159.90' @ 15.00 hrs   Surf.Area= 0.083 ac   Storage= 0.210 af

Plug-Flow detention time= 893.0 min calculated for 0.228 af (75% of inflow)
Center-of-Mass det. time= 800.7 min (1,573.4 - 772.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,156.25'	0.097 af	**18.00'W x 202.00'L x 5.00'H Field A**
			0.417 af Overall - 0.174 af Embedded = 0.243 af x 40.0% Voids
#2A	2,156.75'	0.174 af	**CMP Round 48 x 30 Inside #1**
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.271 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,156.07'	**18.0" Round 18" HDPE**
			L= 82.4' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,156.07' / 2,155.51' S= 0.0068 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.77 sf
#2	Device 1	2,156.07'	**1.2" Vert. 1" Orifice** C= 0.600
#3	Device 1	2,159.75'	**5.0" Vert. 3" Orifice** C= 0.600
#4	Device 1	2,160.25'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.13 cfs @ 15.00 hrs HW=2,159.90'   (Free Discharge)
└─**1=18" HDPE** (Passes 0.13 cfs of 14.93 cfs potential flow)
  ├─**2=1" Orifice** (Orifice Controls 0.07 cfs @ 9.36 fps)
  ├─**3=3" Orifice** (Orifice Controls 0.06 cfs @ 1.31 fps)
  └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: UNDERGROUND DETENTION SYSTEM #1 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

10 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 200.00' Row Length +12.0"
End Stone x 2 = 202.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

30 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
7,590.1 cf Chamber Storage

18,180.0 cf Field - 7,590.1 cf Chambers = 10,589.9 cf Stone x 40.0% Voids = 4,236.0 cf Stone Storage

Chamber Storage + Stone Storage = 11,826.1 cf = 0.271 af
Overall Storage Efficiency = 65.0%
Overall System Size = 202.00' x 18.00' x 5.00'

30 Chambers
673.3 cy Field
392.2 cy Stone
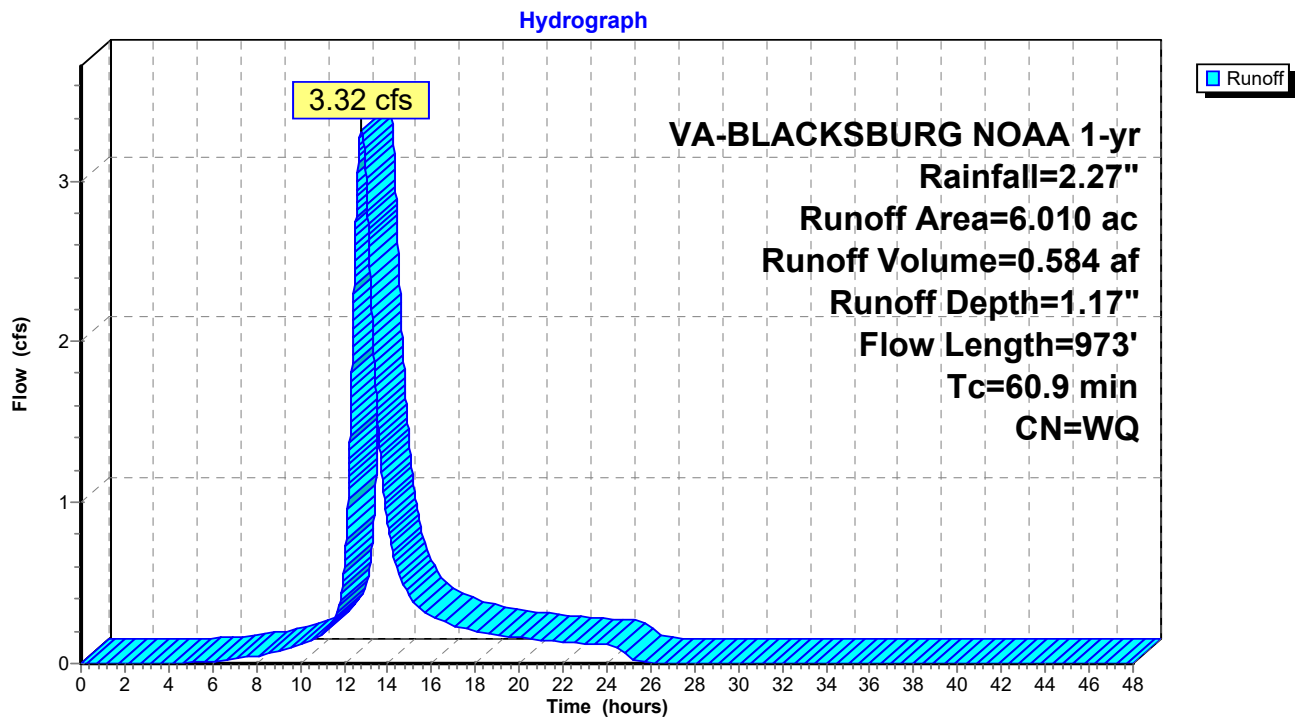
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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
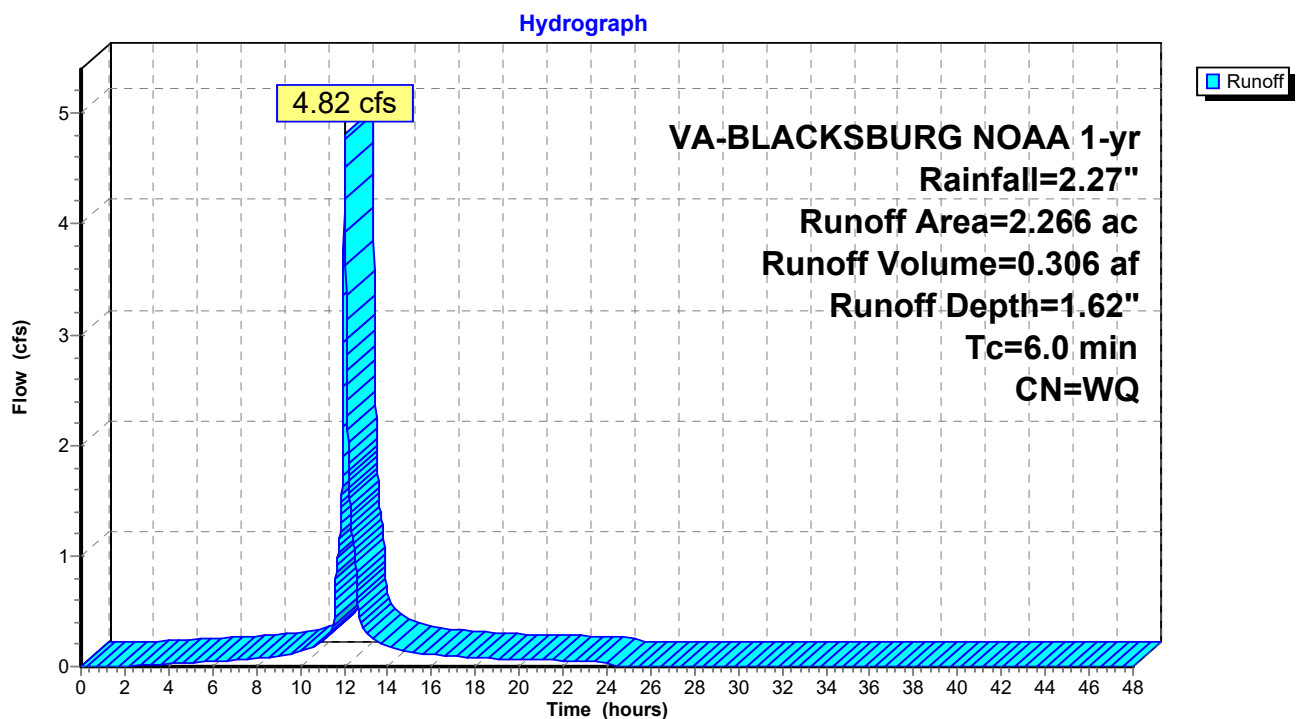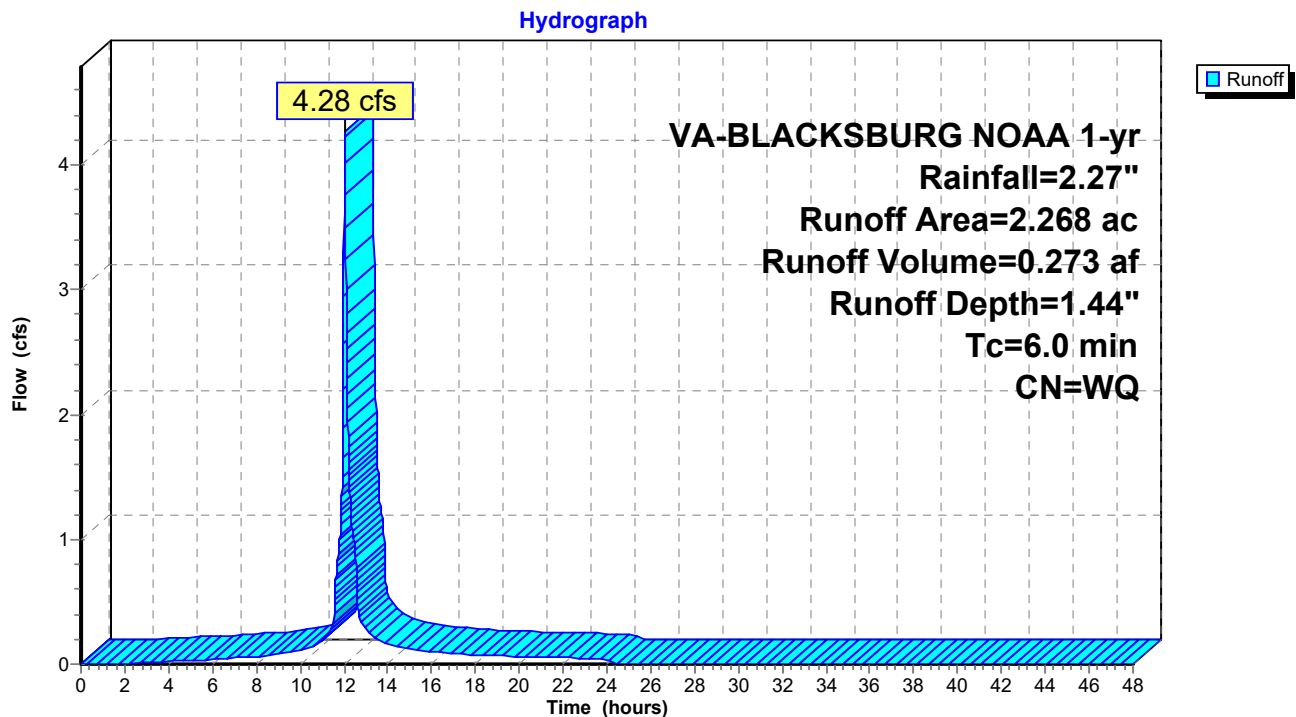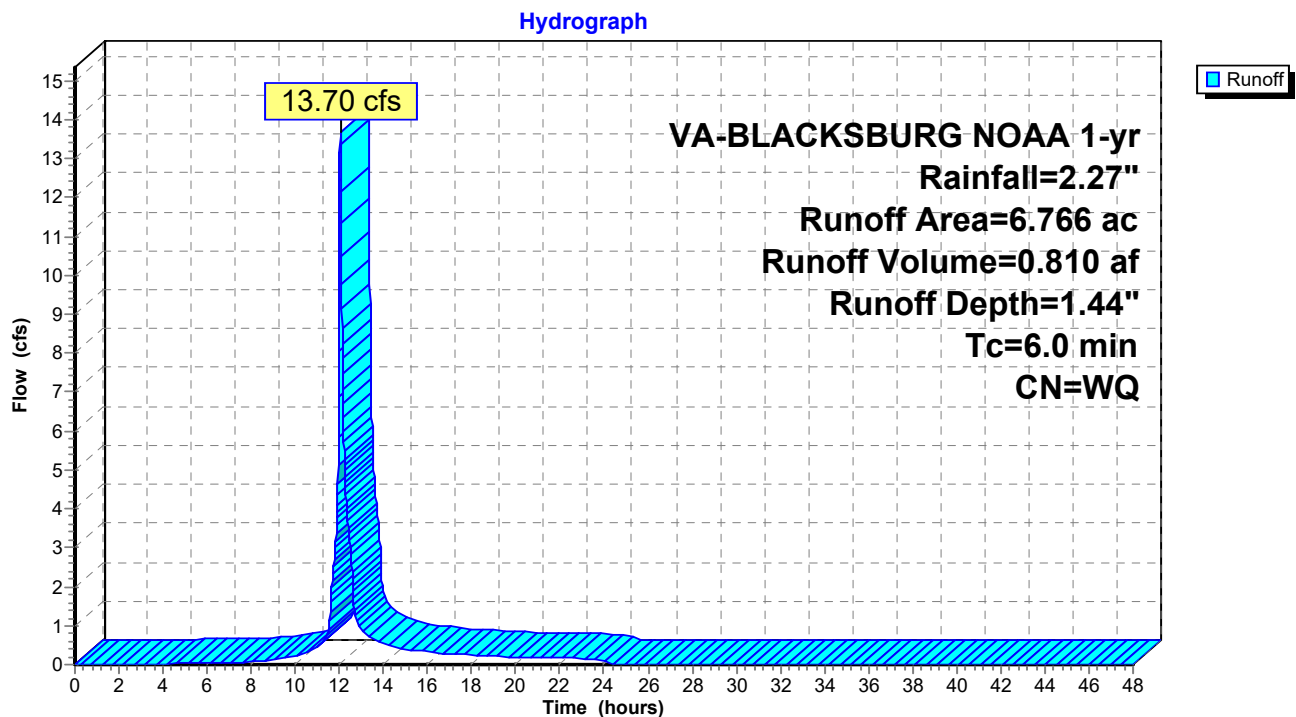Printed 8/1/2018
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Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Summary for Pond 2P: UNDERGROUND DETENTION SYSTEM #2

Inflow Area =   2.268 ac, Inflow Depth =   1.44"   for 1-yr event
Inflow   =   4.28 cfs @ 12.04 hrs, Volume=   0.273 af
Outflow   =   0.12 cfs @ 15.18 hrs, Volume=   0.273 af, Atten= 97%, Lag= 188.5 min
Primary   =   0.12 cfs @ 15.18 hrs, Volume=   0.273 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,157.10' @ 15.18 hrs   Surf.Area= 0.075 ac   Storage= 0.158 af

Plug-Flow detention time= 620.9 min calculated for 0.273 af (100% of inflow)
Center-of-Mass det. time= 620.8 min (1,399.1 - 778.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,154.00'	0.088 af	**18.00'W x 182.00'L x 5.00'H Field A**
			0.376 af Overall - 0.157 af Embedded = 0.219 af x 40.0% Voids
#2A	2,154.50'	0.157 af	**CMP Round 48 x 27 Inside #1**
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.245 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,153.85'	**15.0" Round 15" HDPE**
			L= 37.1' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,153.85' / 2,153.55' S= 0.0081 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.23 sf
#2	Device 1	2,153.85'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,158.00'	**8.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	2,158.15'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.12 cfs @ 15.18 hrs HW=2,157.10'   (Free Discharge)
└─**1=15" HDPE** (Passes 0.12 cfs of 9.58 cfs potential flow)
　├─**2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.12 cfs)
　├─**3=Orifice/Grate** (Controls 0.00 cfs)
　└─**4=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 2P: UNDERGROUND DETENTION SYSTEM #2 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

9 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 180.00' Row Length +12.0"
End Stone x 2 = 182.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

27 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
6,836.1 cf Chamber Storage

16,380.0 cf Field - 6,836.1 cf Chambers = 9,543.9 cf Stone x 40.0% Voids = 3,817.6 cf Stone Storage

Chamber Storage + Stone Storage = 10,653.7 cf = 0.245 af
Overall Storage Efficiency = 65.0%
Overall System Size = 182.00' x 18.00' x 5.00'

27 Chambers
606.7 cy Field
353.5 cy Stone

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Pond 2P: UNDERGROUND DETENTION SYSTEM #2

Hydrograph

- Inflow
- Primary

4.28 cfs

0.12 cfs

Inflow Area=2.268 ac
Peak Elev=2,157.10'
Storage=0.158 af

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Summary for Link 1L: POA #1

Inflow Area =   8.276 ac, Inflow Depth > 1.18"   for 1-yr event
Inflow   =   3.39 cfs @ 12.79 hrs, Volume=   0.812 af
Primary   =   3.39 cfs @ 12.79 hrs, Volume=   0.812 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1
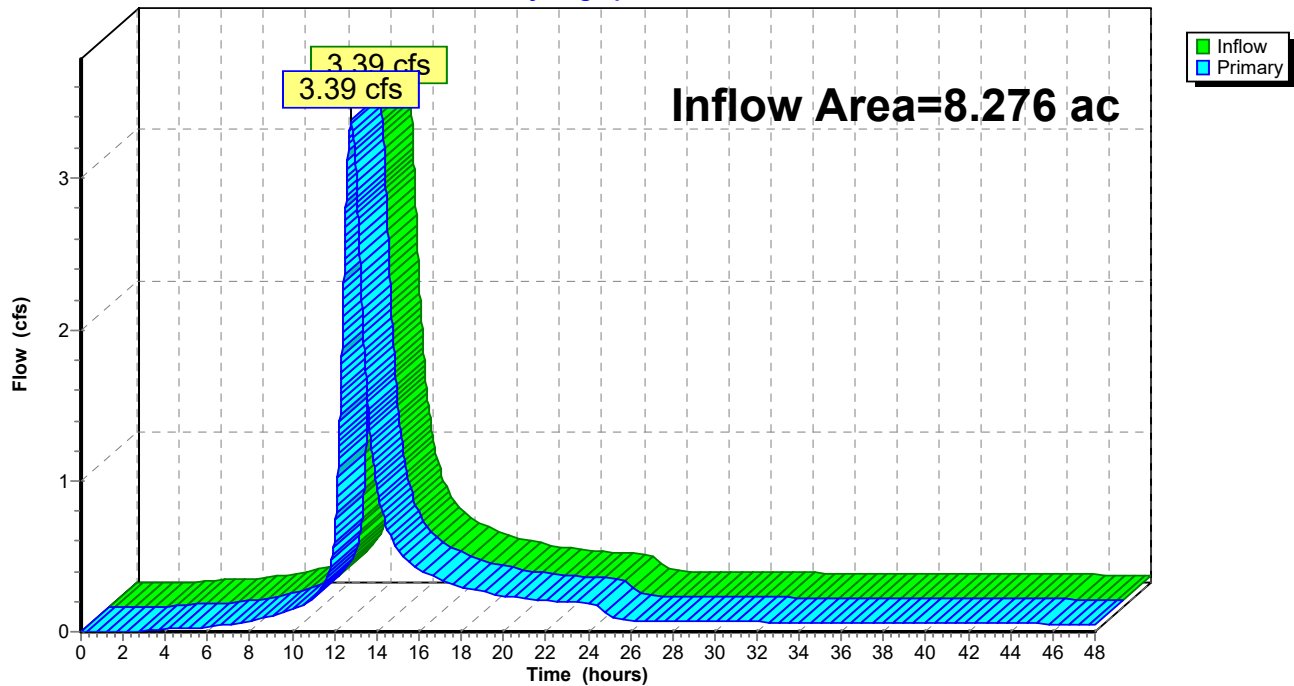
Hydrograph

Summary for Link 2L: MH-A

Inflow Area =   2.268 ac, Inflow Depth =   1.44"   for 1-yr event
Inflow   =   0.12 cfs @   15.18 hrs, Volume=   0.273 af
Primary   =   0.12 cfs @   15.18 hrs, Volume=   0.273 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: MH-A

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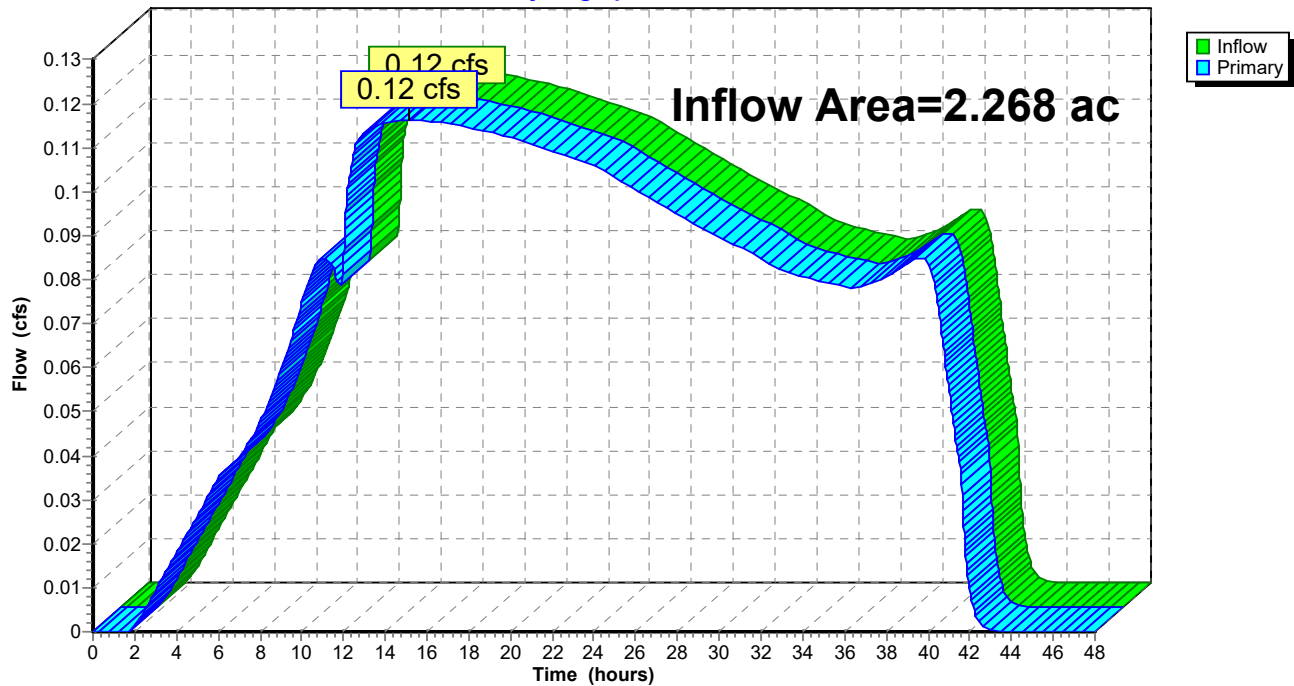
Summary for Link 3L: POA #2

Inflow Area =   9.034 ac, Inflow Depth =   1.44"   for 1-yr event
Inflow   =   13.79 cfs @   12.04 hrs, Volume=   1.083 af
Primary   =   13.79 cfs @   12.04 hrs, Volume=   1.083 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2
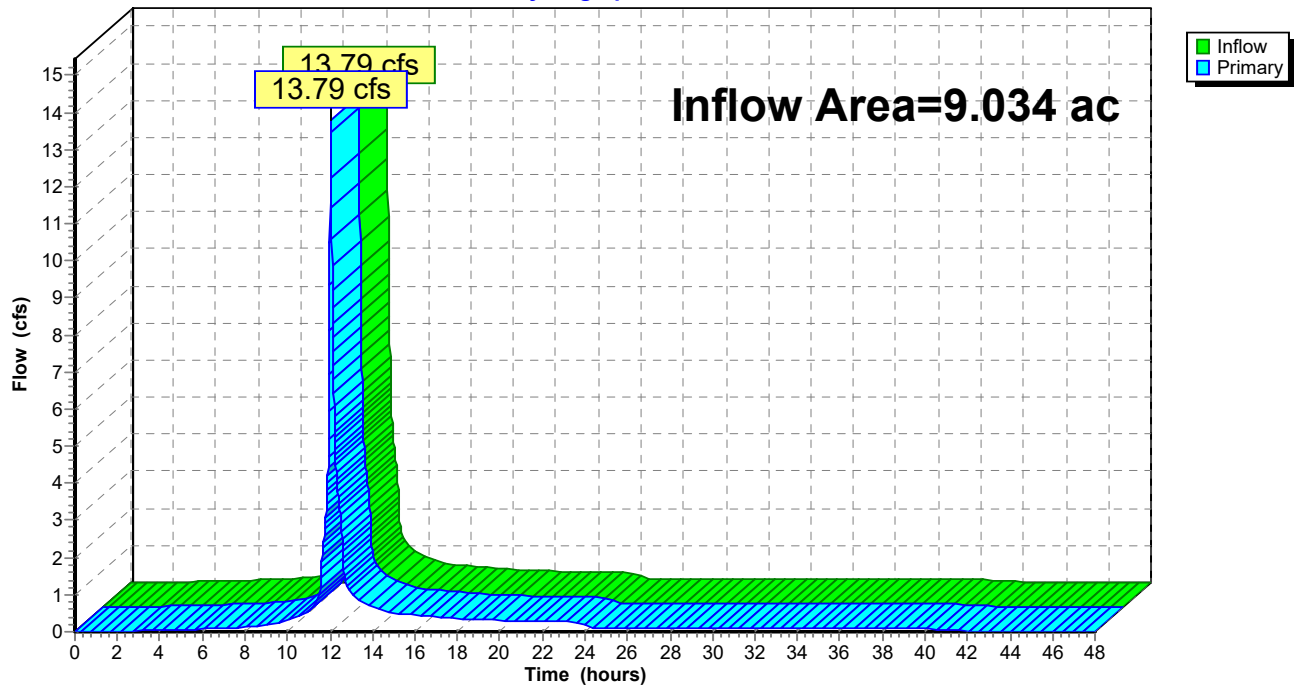
Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: BYPASS AREA Runoff Area=6.010 ac Runoff Depth=1.54"
Flow Length=973' Tc=60.9 min CN=WQ Runoff=4.39 cfs 0.770 af

Subcatchment 2S: DA TO DETENTION SYSTEM #1 Runoff Area=2.266 ac Runoff Depth=2.03"
Tc=6.0 min CN=WQ Runoff=6.00 cfs 0.384 af

Subcatchment 3S: DA TO DETENTION SYSTEM #2 Runoff Area=2.268 ac Runoff Depth=1.84"
Tc=6.0 min CN=WQ Runoff=5.42 cfs 0.347 af

Subcatchment 5S: BYPASS AREA Runoff Area=6.766 ac Runoff Depth=1.87"
Tc=6.0 min CN=WQ Runoff=17.73 cfs 1.053 af

Pond 1P: UNDERGROUND DETENTION Peak Elev=2,160.28' Storage=0.232 af Inflow=6.00 cfs 0.384 af
Outflow=0.53 cfs 0.303 af

Pond 2P: UNDERGROUND DETENTION Peak Elev=2,158.03' Storage=0.209 af Inflow=5.42 cfs 0.347 af
Outflow=0.14 cfs 0.347 af

Link 1L: POA #1 Inflow=4.89 cfs 1.074 af
Primary=4.89 cfs 1.074 af

Link 2L: MH-A Inflow=0.14 cfs 0.347 af
Primary=0.14 cfs 0.347 af

Link 3L: POA #2 Inflow=17.83 cfs 1.400 af
Primary=17.83 cfs 1.400 af

Total Runoff Area = 17.310 ac Runoff Volume = 2.554 af Average Runoff Depth = 1.77"

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Summary for Subcatchment 1S: BYPASS AREA

Runoff   =   4.39 cfs @ 12.79 hrs, Volume=   0.770 af, Depth= 1.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.433	61	>75% Grass cover, Good, HSG B
0.407	74	>75% Grass cover, Good, HSG C
0.270	55	Woods, Good, HSG B
0.076	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.068	98	Paved parking, HSG B
0.056	98	Paved parking, HSG C
6.010		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.4	150	0.0233	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
6.7	415	0.0422	1.03		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
60.9	973	Total			

Subcatchment 1S: BYPASS AREA
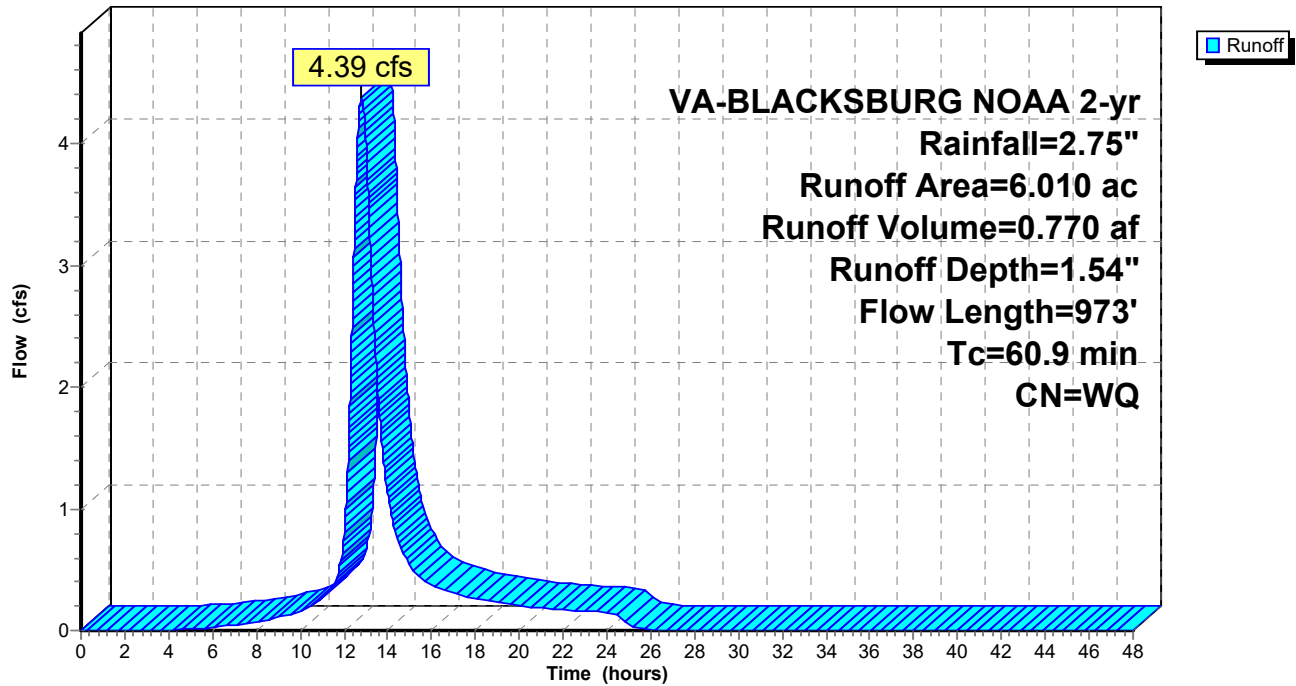
Hydrograph

VA-BLACKSBURG NOAA 2-yr
Rainfall=2.75"
Runoff Area=6.010 ac
Runoff Volume=0.770 af
Runoff Depth=1.54"
Flow Length=973'
Tc=60.9 min
CN=WQ

POST DEV
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Summary for Subcatchment 2S: DA TO DETENTION SYSTEM #1

Runoff   =   6.00 cfs @ 12.04 hrs, Volume=   0.384 af, Depth= 2.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.176	61	>75% Grass cover, Good, HSG B
0.401	74	>75% Grass cover, Good, HSG C
0.339	98	Paved parking, HSG B
1.350	98	Paved parking, HSG C
2.266		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 2S: DA TO DETENTION SYSTEM #1

POST DEV
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Summary for Subcatchment 3S: DA TO DETENTION SYSTEM #2

Runoff   =   5.42 cfs @   12.04 hrs, Volume=   0.347 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.071	61	>75% Grass cover, Good, HSG B
0.621	74	>75% Grass cover, Good, HSG C
0.064	55	Woods, Good, HSG B
0.074	70	Woods, Good, HSG C
0.135	98	Paved roads w/curbs & sewers, HSG C
0.131	98	Paved parking, HSG B
1.172	98	Paved parking, HSG C
2.268		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: DA TO DETENTION SYSTEM #2

Hydrograph

VA-BLACKSBURG NOAA 2-yr
Rainfall=2.75"
Runoff Area=2.268 ac
Runoff Volume=0.347 af
Runoff Depth=1.84"
Tc=6.0 min
CN=WQ

Summary for Subcatchment 5S: BYPASS AREA

Runoff   =   17.73 cfs @ 12.04 hrs, Volume=   1.053 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.878	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.384	98	Paved roads w/curbs & sewers, HSG C
6.766		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 5S: BYPASS AREA

Hydrograph

Subcatchment 5S: BYPASS AREA hydrograph showing Runoff peak of 17.73 cfs at approximately 12 hours. VA-BLACKSBURG NOAA 2-yr, Rainfall=2.75", Runoff Area=6.766 ac, Runoff Volume=1.053 af, Runoff Depth=1.87", Tc=6.0 min, CN=WQ

Summary for Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Inflow Area =   2.266 ac, Inflow Depth =   2.03"   for 2-yr event
Inflow   =   6.00 cfs @   12.04 hrs, Volume=   0.384 af
Outflow   =   0.53 cfs @   12.69 hrs, Volume=   0.303 af, Atten= 91%, Lag= 39.4 min
Primary   =   0.53 cfs @   12.69 hrs, Volume=   0.303 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,160.28' @ 12.69 hrs   Surf.Area= 0.083 ac   Storage= 0.232 af

Plug-Flow detention time= 711.1 min calculated for 0.303 af (79% of inflow)
Center-of-Mass det. time= 627.3 min (1,396.5 - 769.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,156.25'	0.097 af	**18.00'W x 202.00'L x 5.00'H Field A**
			0.417 af Overall - 0.174 af Embedded = 0.243 af x 40.0% Voids
#2A	2,156.75'	0.174 af	**CMP Round 48** x 30 Inside #1
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.271 af	Total Available Storage

  Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,156.07'	**18.0" Round 18" HDPE**
			L= 82.4' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,156.07' / 2,155.51' S= 0.0068 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.77 sf
#2	Device 1	2,156.07'	**1.2" Vert. 1" Orifice** C= 0.600
#3	Device 1	2,159.75'	**5.0" Vert. 3" Orifice** C= 0.600
#4	Device 1	2,160.25'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.52 cfs @ 12.69 hrs HW=2,160.28'   (Free Discharge)
└─**1=18" HDPE** (Passes 0.52 cfs of 15.83 cfs potential flow)
  ├─**2=1" Orifice** (Orifice Controls 0.08 cfs @ 9.82 fps)
  ├─**3=3" Orifice** (Orifice Controls 0.37 cfs @ 2.73 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.07 cfs @ 0.48 fps)

Pond 1P: UNDERGROUND DETENTION SYSTEM #1 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

10 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 200.00' Row Length +12.0"
End Stone x 2 = 202.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

30 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
7,590.1 cf Chamber Storage

18,180.0 cf Field - 7,590.1 cf Chambers = 10,589.9 cf Stone x 40.0% Voids = 4,236.0 cf Stone Storage

Chamber Storage + Stone Storage = 11,826.1 cf = 0.271 af
Overall Storage Efficiency = 65.0%
Overall System Size = 202.00' x 18.00' x 5.00'

30 Chambers
673.3 cy Field
392.2 cy Stone

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VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"
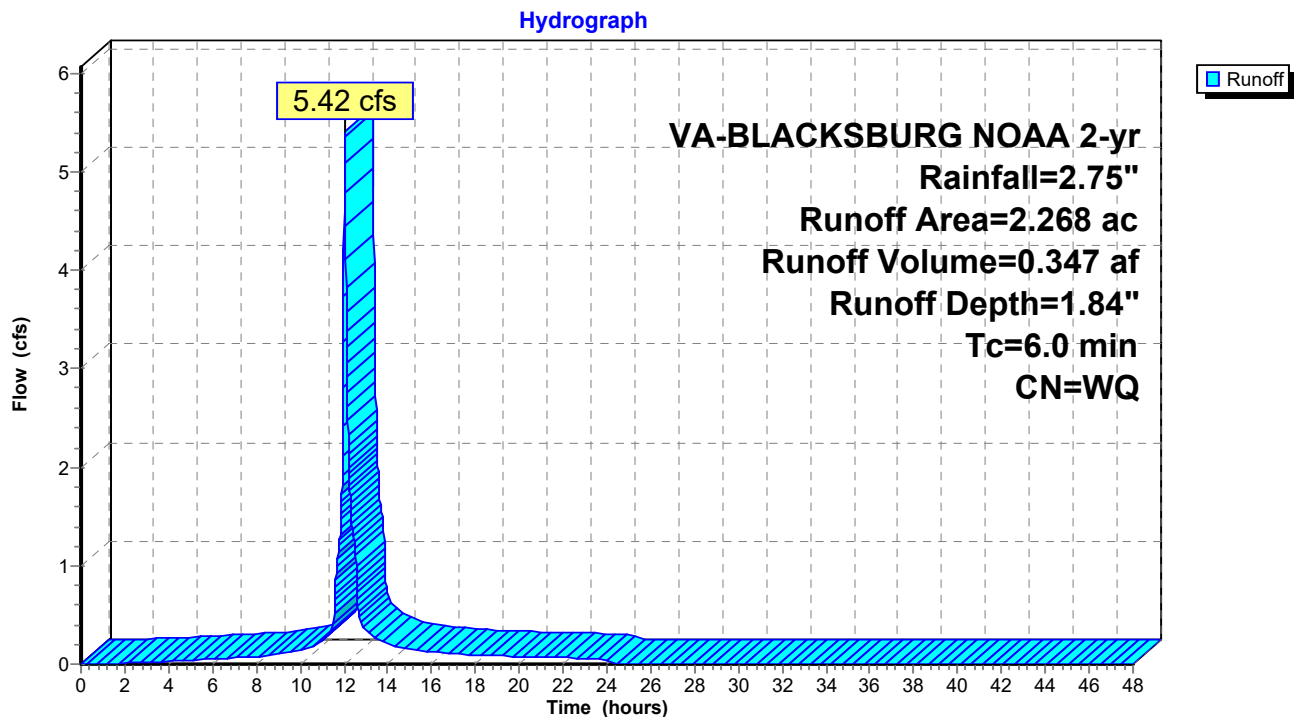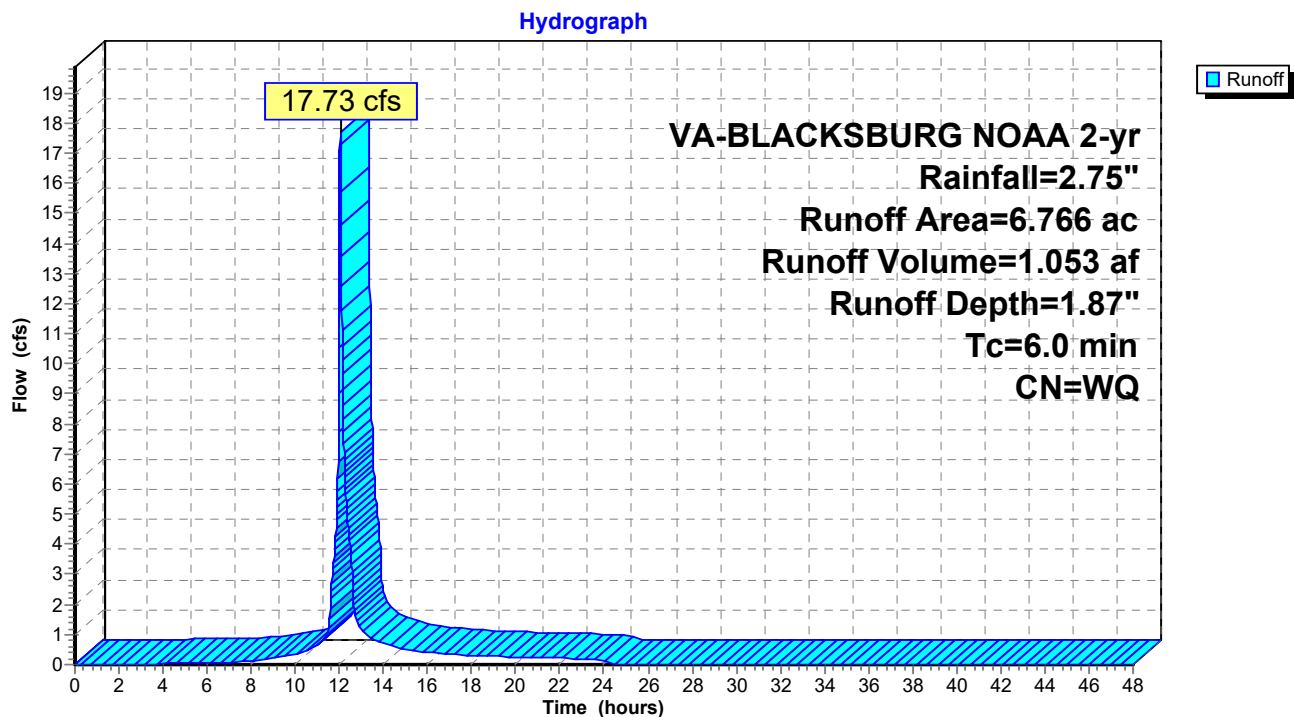Printed 8/1/2018
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Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Hydrograph

Inflow Area=2.266 ac
Peak Elev=2,160.28'
Storage=0.232 af

Legend: Inflow, Primary

6.00 cfs

0.53 cfs

Flow (cfs) — Time (hours)

Summary for Pond 2P: UNDERGROUND DETENTION SYSTEM #2

Inflow Area =   2.268 ac, Inflow Depth =   1.84"   for 2-yr event
Inflow   =   5.42 cfs @   12.04 hrs, Volume=   0.347 af
Outflow   =   0.14 cfs @   15.25 hrs, Volume=   0.347 af, Atten= 97%, Lag= 192.8 min
Primary   =   0.14 cfs @   15.25 hrs, Volume=   0.347 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,158.03' @ 15.25 hrs   Surf.Area= 0.075 ac   Storage= 0.209 af

Plug-Flow detention time= 736.9 min calculated for 0.347 af (100% of inflow)
Center-of-Mass det. time= 736.8 min (1,512.2 - 775.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,154.00'	0.088 af	**18.00'W x 182.00'L x 5.00'H Field A**
			0.376 af Overall - 0.157 af Embedded = 0.219 af x 40.0% Voids
#2A	2,154.50'	0.157 af	**CMP Round 48** x 27 Inside #1
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.245 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,153.85'	**15.0" Round 15" HDPE**
			L= 37.1' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,153.85' / 2,153.55' S= 0.0081 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.23 sf
#2	Device 1	2,153.85'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,158.00'	**8.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	2,158.15'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.14 cfs @ 15.25 hrs HW=2,158.03'   (Free Discharge)
└─**1=15" HDPE** (Passes 0.14 cfs of 11.14 cfs potential flow)
  ├─**2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.13 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.57 fps)
  └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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VA-BLACKSBURG NOAA 2-yr Rainfall=2.75"
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Pond 2P: UNDERGROUND DETENTION SYSTEM #2 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

9 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 180.00' Row Length +12.0"
End Stone x 2 = 182.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

27 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
6,836.1 cf Chamber Storage

16,380.0 cf Field - 6,836.1 cf Chambers = 9,543.9 cf Stone x 40.0% Voids = 3,817.6 cf Stone Storage

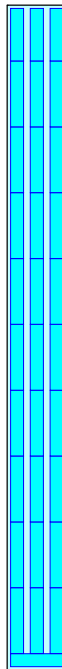Chamber Storage + Stone Storage = 10,653.7 cf = 0.245 af
Overall Storage Efficiency = 65.0%
Overall System Size = 182.00' x 18.00' x 5.00'
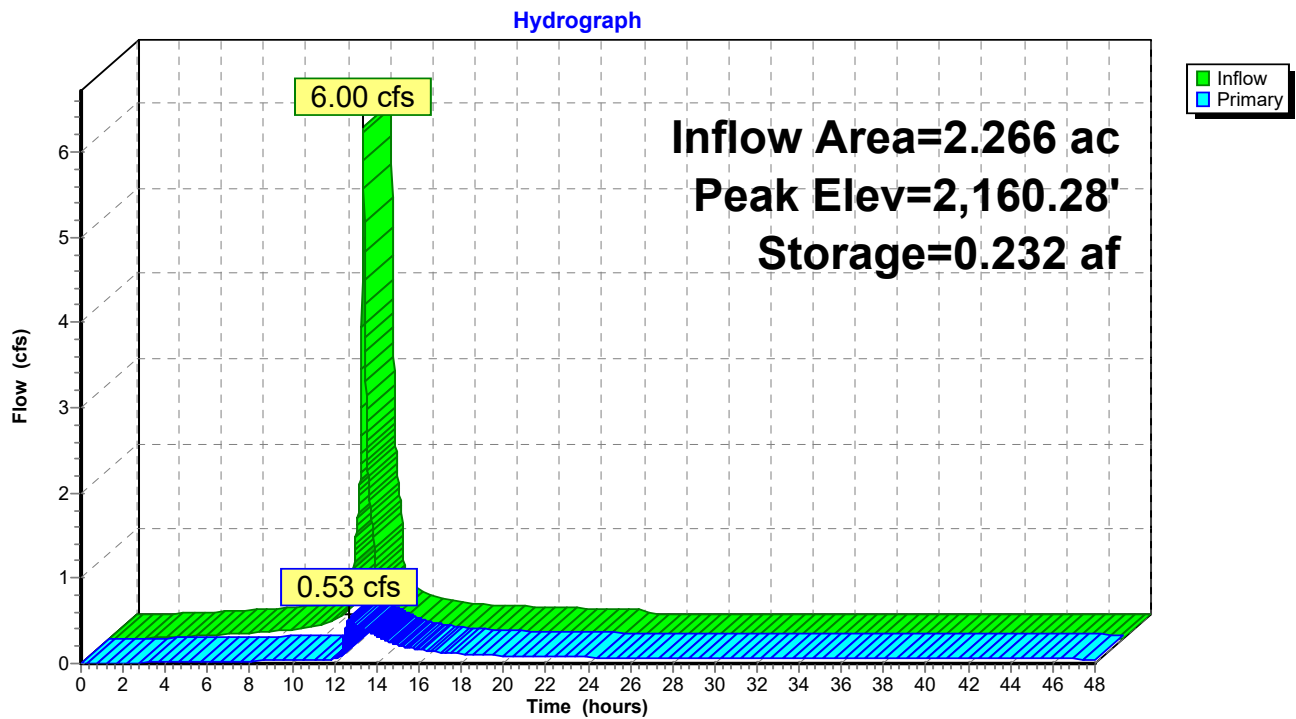
27 Chambers
606.7 cy Field
353.5 cy Stone

Pond 2P: UNDERGROUND DETENTION SYSTEM #2
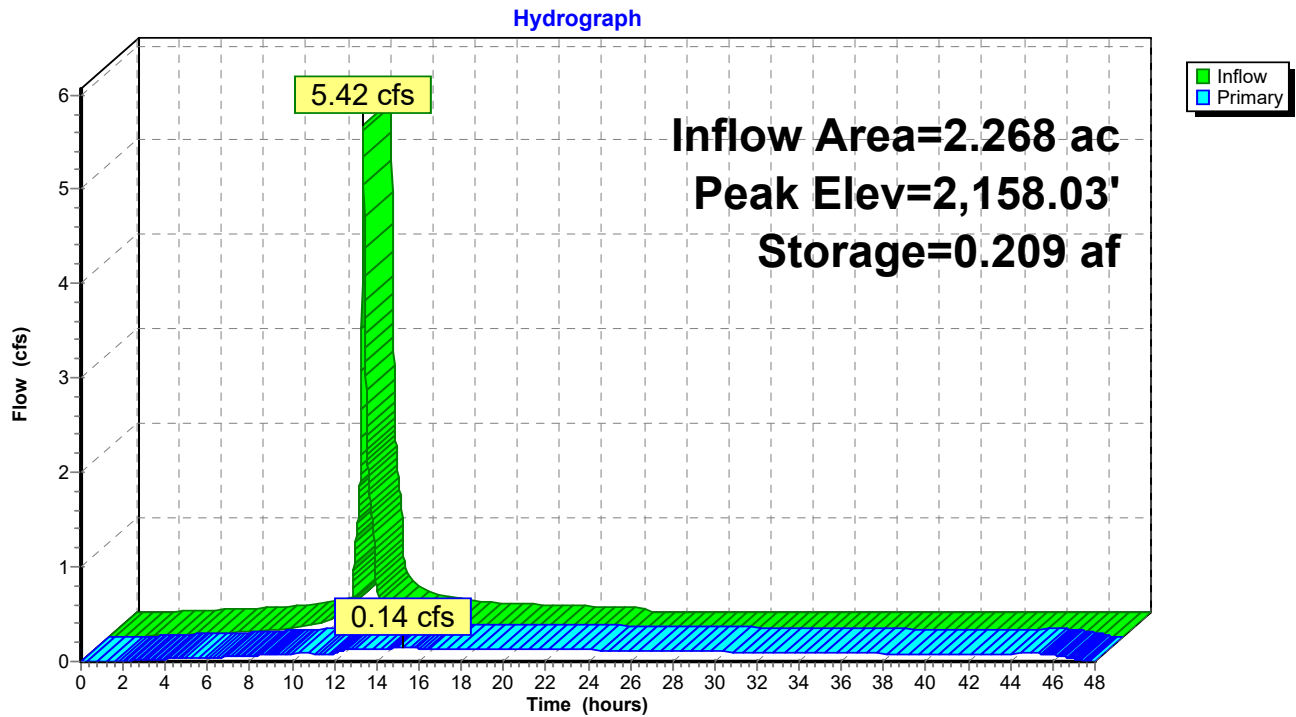
Hydrograph

Inflow Area=2.268 ac
Peak Elev=2,158.03'
Storage=0.209 af

5.42 cfs

0.14 cfs

- Inflow
- Primary

Flow (cfs)

Time (hours)

Summary for Link 1L: POA #1

Inflow Area =   8.276 ac, Inflow Depth > 1.56"   for 2-yr event
Inflow   =   4.89 cfs @   12.79 hrs, Volume=   1.074 af
Primary   =   4.89 cfs @   12.79 hrs, Volume=   1.074 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1
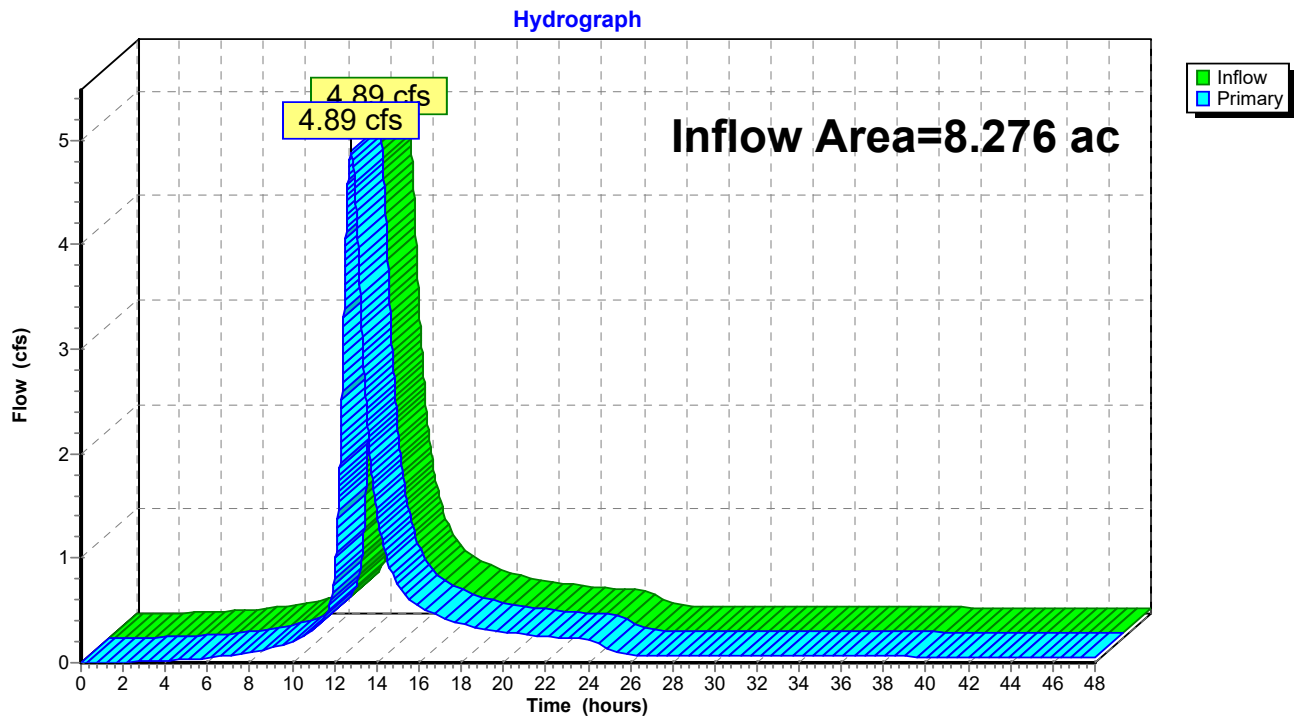
Hydrograph

Summary for Link 2L: MH-A

Inflow Area =   2.268 ac, Inflow Depth > 1.83"   for 2-yr event
Inflow   =   0.14 cfs @   15.25 hrs, Volume=   0.347 af
Primary   =   0.14 cfs @   15.25 hrs, Volume=   0.347 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: MH-A
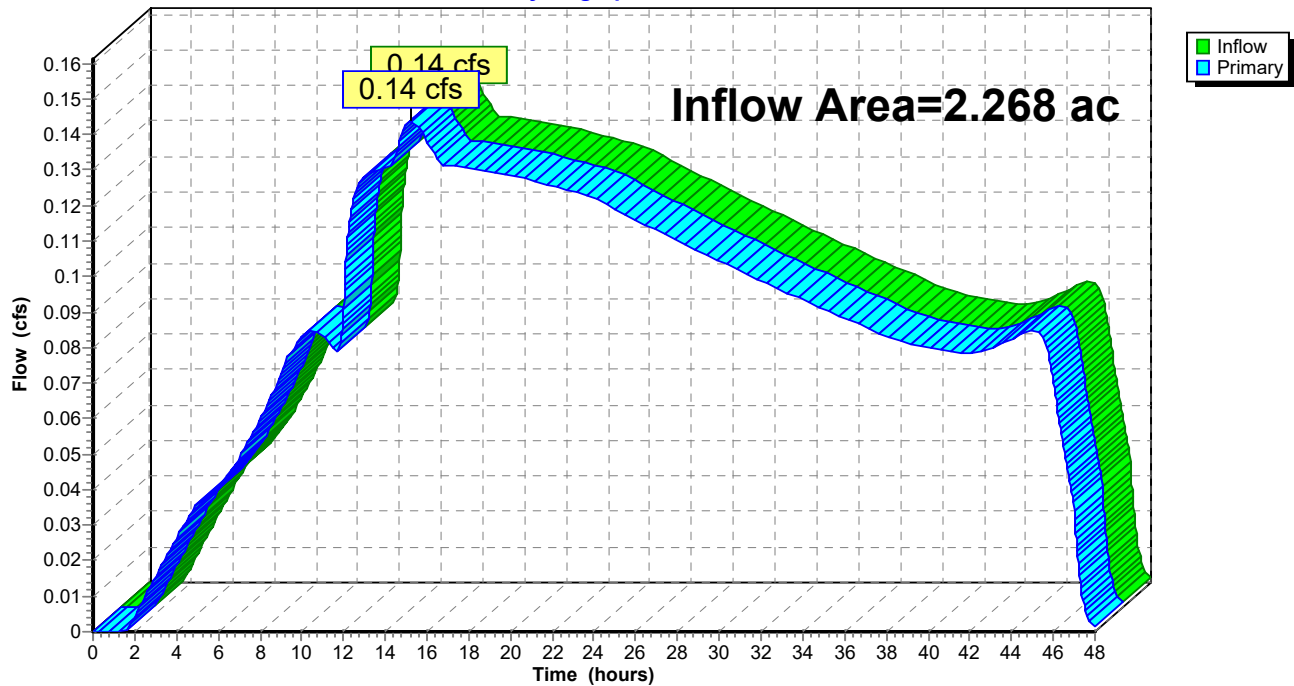
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Summary for Link 3L: POA #2

Inflow Area =   9.034 ac, Inflow Depth =   1.86"   for 2-yr event
Inflow   =   17.83 cfs @   12.04 hrs, Volume=   1.400 af
Primary   =   17.83 cfs @   12.04 hrs, Volume=   1.400 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: BYPASS AREA Runoff Area=6.010 ac Runoff Depth=2.65"
Flow Length=973' Tc=60.9 min CN=WQ Runoff=7.36 cfs 1.329 af

Subcatchment 2S: DA TO DETENTION SYSTEM #1 Runoff Area=2.266 ac Runoff Depth=3.23"
Tc=6.0 min CN=WQ Runoff=8.71 cfs 0.611 af

Subcatchment 3S: DA TO DETENTION SYSTEM #2 Runoff Area=2.268 ac Runoff Depth=2.99"
Tc=6.0 min CN=WQ Runoff=8.09 cfs 0.565 af

Subcatchment 5S: BYPASS AREA Runoff Area=6.766 ac Runoff Depth=3.12"
Tc=6.0 min CN=WQ Runoff=26.79 cfs 1.758 af

Pond 1P: UNDERGROUND DETENTION Peak Elev=2,160.72' Storage=0.254 af Inflow=8.71 cfs 0.611 af
Outflow=5.50 cfs 0.527 af

Pond 2P: UNDERGROUND DETENTION Peak Elev=2,158.48' Storage=0.229 af Inflow=8.09 cfs 0.565 af
Outflow=3.51 cfs 0.558 af

Link 1L: POA #1 Inflow=8.46 cfs 1.856 af
Primary=8.46 cfs 1.856 af

Link 2L: MH-A Inflow=3.51 cfs 0.558 af
Primary=3.51 cfs 0.558 af

Link 3L: POA #2 Inflow=26.91 cfs 2.316 af
Primary=26.91 cfs 2.316 af

Total Runoff Area = 17.310 ac Runoff Volume = 4.262 af Average Runoff Depth = 2.95"

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Summary for Subcatchment 1S: BYPASS AREA

Runoff   =   7.36 cfs @   12.79 hrs, Volume=   1.329 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.433	61	>75% Grass cover, Good, HSG B
0.407	74	>75% Grass cover, Good, HSG C
0.270	55	Woods, Good, HSG B
0.076	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.068	98	Paved parking, HSG B
0.056	98	Paved parking, HSG C
6.010		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.4	150	0.0233	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
6.7	415	0.0422	1.03		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
60.9	973	Total			

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*VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"*
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Subcatchment 1S: BYPASS AREA

Hydrograph

VA-BLACKSBURG NOAA 10-yr
Rainfall=4.09"
Runoff Area=6.010 ac
Runoff Volume=1.329 af
Runoff Depth=2.65"
Flow Length=973'
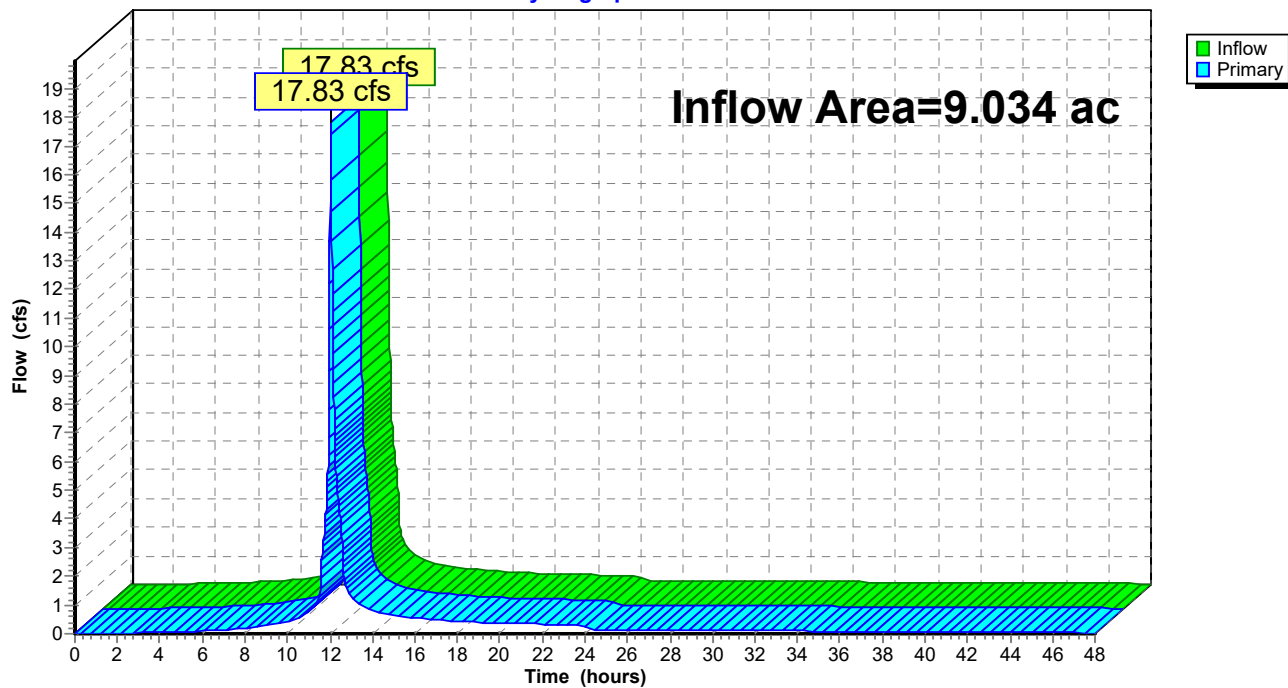**Tc=60.9 min**
CN=WQ

7.36 cfs

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Summary for Subcatchment 2S: DA TO DETENTION SYSTEM #1

Runoff   =   8.71 cfs @ 12.04 hrs, Volume=   0.611 af, Depth= 3.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.176	61	>75% Grass cover, Good, HSG B
0.401	74	>75% Grass cover, Good, HSG C
0.339	98	Paved parking, HSG B
1.350	98	Paved parking, HSG C
2.266		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 2S: DA TO DETENTION SYSTEM #1

Hydrograph

VA-BLACKSBURG NOAA 10-yr
Rainfall=4.09"
Runoff Area=2.266 ac
Runoff Volume=0.611 af
Runoff Depth=3.23"
Tc=6.0 min
CN=WQ

8.71 cfs

Summary for Subcatchment 3S: DA TO DETENTION SYSTEM #2

Runoff   =   8.09 cfs @   12.04 hrs, Volume=   0.565 af, Depth= 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.071	61	>75% Grass cover, Good, HSG B
0.621	74	>75% Grass cover, Good, HSG C
0.064	55	Woods, Good, HSG B
0.074	70	Woods, Good, HSG C
0.135	98	Paved roads w/curbs & sewers, HSG C
0.131	98	Paved parking, HSG B
1.172	98	Paved parking, HSG C
2.268		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: DA TO DETENTION SYSTEM #2

VA-BLACKSBURG NOAA 10-yr
Rainfall=4.09"
Runoff Area=2.268 ac
Runoff Volume=0.565 af
Runoff Depth=2.99"
Tc=6.0 min
CN=WQ

Summary for Subcatchment 5S: BYPASS AREA

Runoff = 26.79 cfs @ 12.04 hrs, Volume= 1.758 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
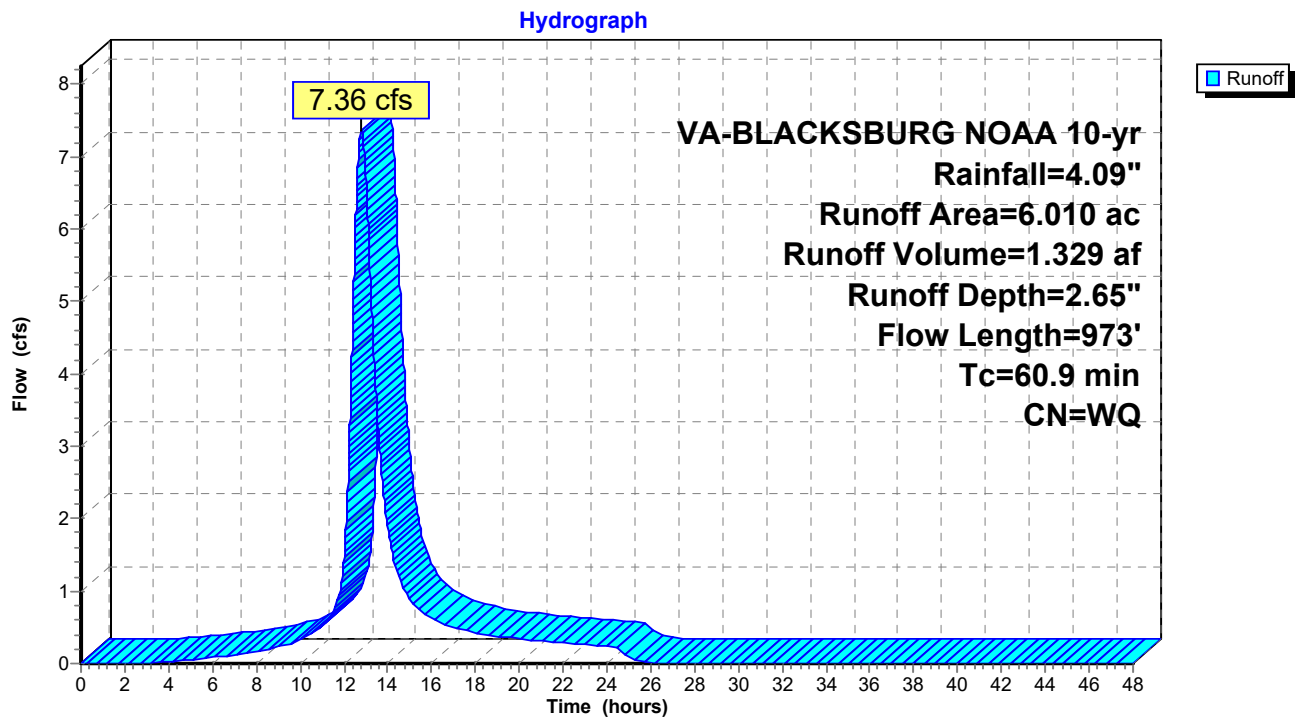VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.878	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.384	98	Paved roads w/curbs & sewers, HSG C
6.766		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 5S: BYPASS AREA

Hydrograph

VA-BLACKSBURG NOAA 10-yr
Rainfall=4.09"
Runoff Area=6.766 ac
Runoff Volume=1.758 af
Runoff Depth=3.12"
Tc=6.0 min
CN=WQ

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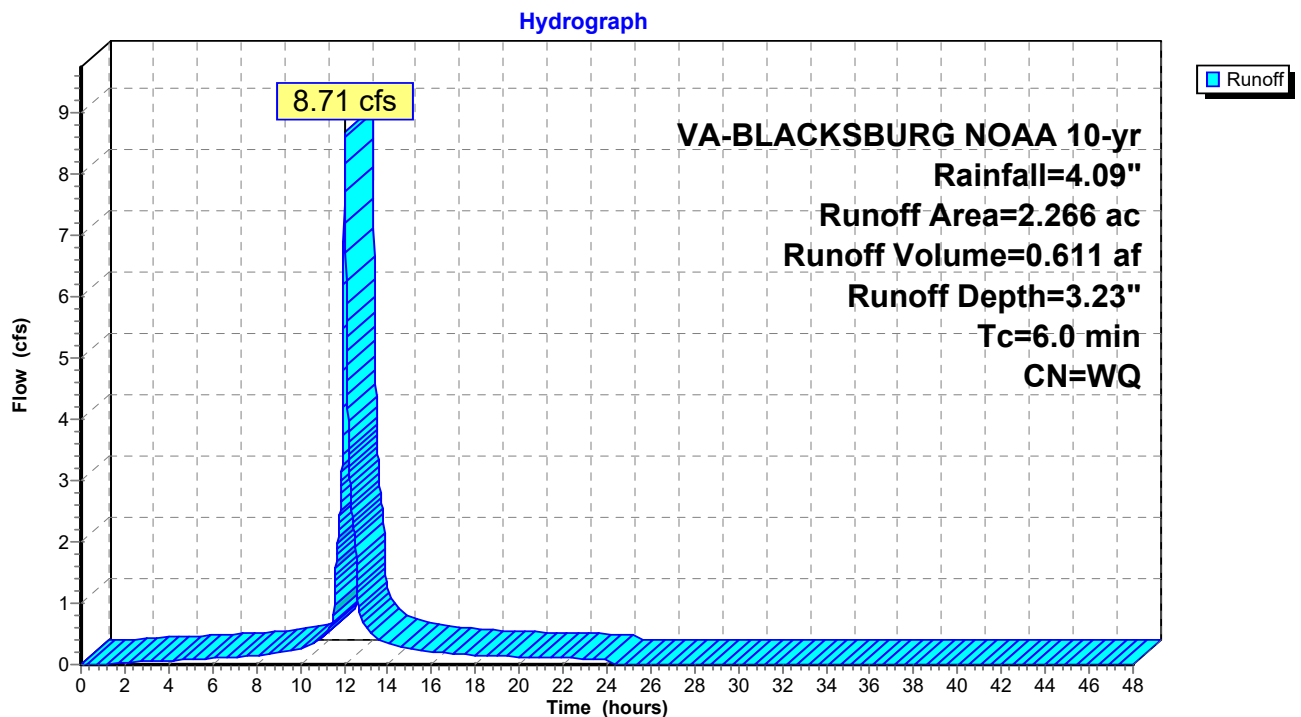*VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"*
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Summary for Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Inflow Area =   2.266 ac, Inflow Depth = 3.23"   for 10-yr event
Inflow   =   8.71 cfs @ 12.04 hrs, Volume=   0.611 af
Outflow   =   5.50 cfs @ 12.12 hrs, Volume=   0.527 af, Atten= 37%, Lag= 5.3 min
Primary   =   5.50 cfs @ 12.12 hrs, Volume=   0.527 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,160.72' @ 12.12 hrs   Surf.Area= 0.083 ac   Storage= 0.254 af

Plug-Flow detention time= 453.6 min calculated for 0.527 af (86% of inflow)
Center-of-Mass det. time= 387.3 min (1,150.8 - 763.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,156.25'	0.097 af	**18.00'W x 202.00'L x 5.00'H Field A**
			0.417 af Overall - 0.174 af Embedded = 0.243 af x 40.0% Voids
#2A	2,156.75'	0.174 af	**CMP Round 48 x 30 Inside #1**
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.271 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,156.07'	**18.0" Round 18" HDPE**
			L= 82.4' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,156.07' / 2,155.51' S= 0.0068 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.77 sf
#2	Device 1	2,156.07'	**1.2" Vert. 1" Orifice** C= 0.600
#3	Device 1	2,159.75'	**5.0" Vert. 3" Orifice** C= 0.600
#4	Device 1	2,160.25'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=5.48 cfs @ 12.12 hrs HW=2,160.72'   (Free Discharge)
└─**1=18" HDPE** (Passes 5.48 cfs of 16.81 cfs potential flow)
  ├─**2=1" Orifice** (Orifice Controls 0.08 cfs @ 10.33 fps)
  ├─**3=3" Orifice** (Orifice Controls 0.57 cfs @ 4.21 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 4.82 cfs @ 2.04 fps)

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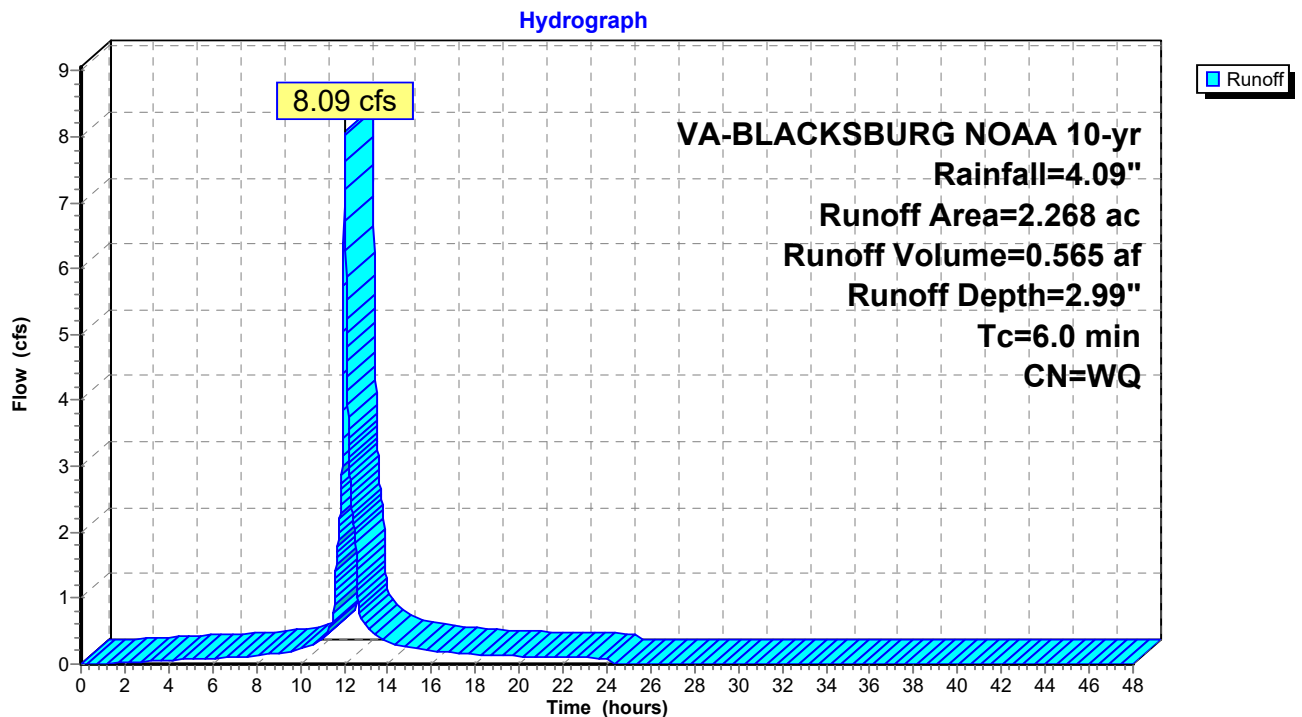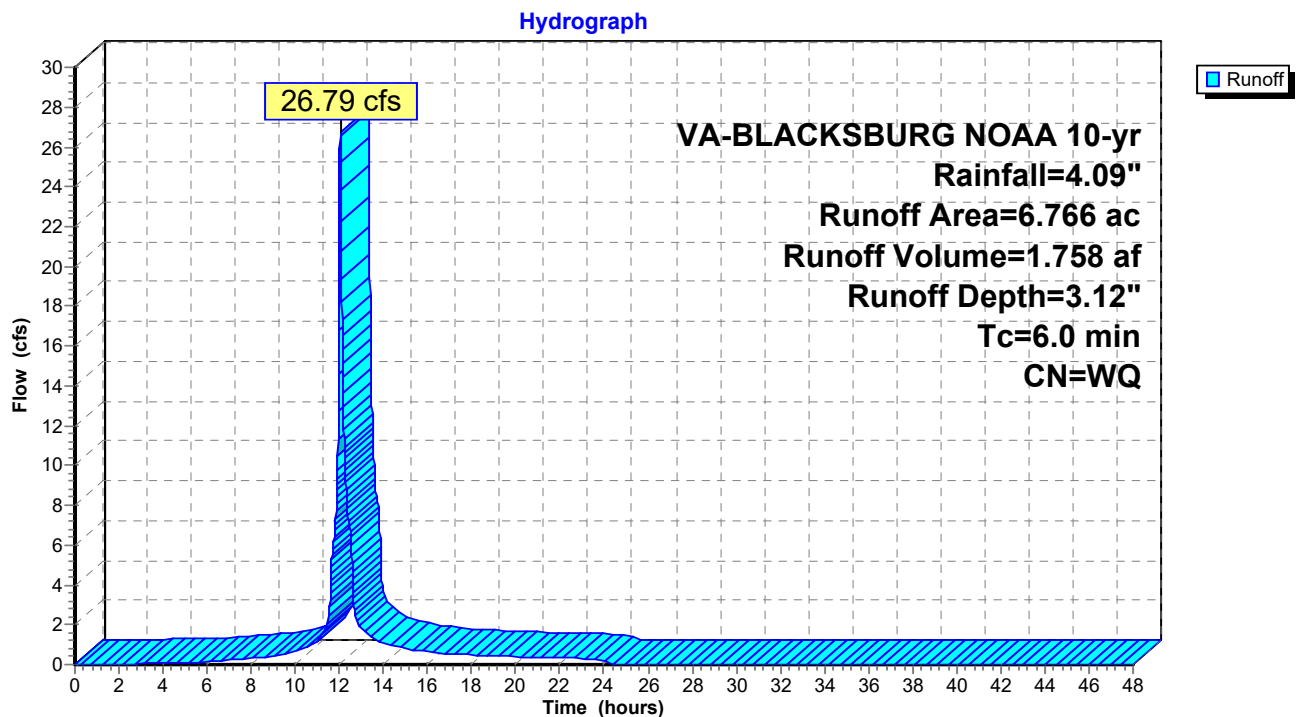*VA-BLACKSBURG NOAA 10-yr Rainfall=4.09"*
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Pond 1P: UNDERGROUND DETENTION SYSTEM #1 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

10 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 200.00' Row Length +12.0"
End Stone x 2 = 202.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

30 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
7,590.1 cf Chamber Storage

18,180.0 cf Field - 7,590.1 cf Chambers = 10,589.9 cf Stone x 40.0% Voids = 4,236.0 cf Stone Storage

Chamber Storage + Stone Storage = 11,826.1 cf = 0.271 af
Overall Storage Efficiency = 65.0%
Overall System Size = 202.00' x 18.00' x 5.00'

30 Chambers
673.3 cy Field
392.2 cy Stone

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Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Hydrograph

Inflow Area=2.266 ac
Peak Elev=2,160.72'
Storage=0.254 af

Summary for Pond 2P: UNDERGROUND DETENTION SYSTEM #2

Inflow Area =   2.268 ac, Inflow Depth =   2.99"   for 10-yr event
Inflow   =   8.09 cfs @   12.04 hrs, Volume=   0.565 af
Outflow   =   3.51 cfs @   12.20 hrs, Volume=   0.558 af, Atten= 57%, Lag= 10.0 min
Primary   =   3.51 cfs @   12.20 hrs, Volume=   0.558 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,158.48' @ 12.20 hrs   Surf.Area= 0.075 ac   Storage= 0.229 af

Plug-Flow detention time= 514.3 min calculated for 0.558 af (99% of inflow)
Center-of-Mass det. time= 506.7 min (1,277.3 - 770.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,154.00'	0.088 af	**18.00'W x 182.00'L x 5.00'H Field A**
			0.376 af Overall - 0.157 af Embedded = 0.219 af x 40.0% Voids
#2A	2,154.50'	0.157 af	**CMP Round 48** x 27 Inside #1
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.245 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,153.85'	**15.0" Round 15" HDPE**
			L= 37.1' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,153.85' / 2,153.55' S= 0.0081 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.23 sf
#2	Device 1	2,153.85'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,158.00'	**8.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	2,158.15'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=3.50 cfs @ 12.20 hrs HW=2,158.48'   (Free Discharge)
└─**1=15" HDPE** (Passes 3.50 cfs of 11.83 cfs potential flow)
  ├─**2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.14 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.59 cfs @ 2.68 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 2.77 cfs @ 1.66 fps)

Pond 2P: UNDERGROUND DETENTION SYSTEM #2 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

9 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 180.00' Row Length +12.0"
End Stone x 2 = 182.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

27 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
6,836.1 cf Chamber Storage

16,380.0 cf Field - 6,836.1 cf Chambers = 9,543.9 cf Stone x 40.0% Voids = 3,817.6 cf Stone Storage
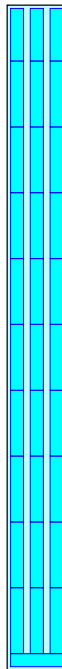
Chamber Storage + Stone Storage = 10,653.7 cf = 0.245 af
Overall Storage Efficiency = 65.0%
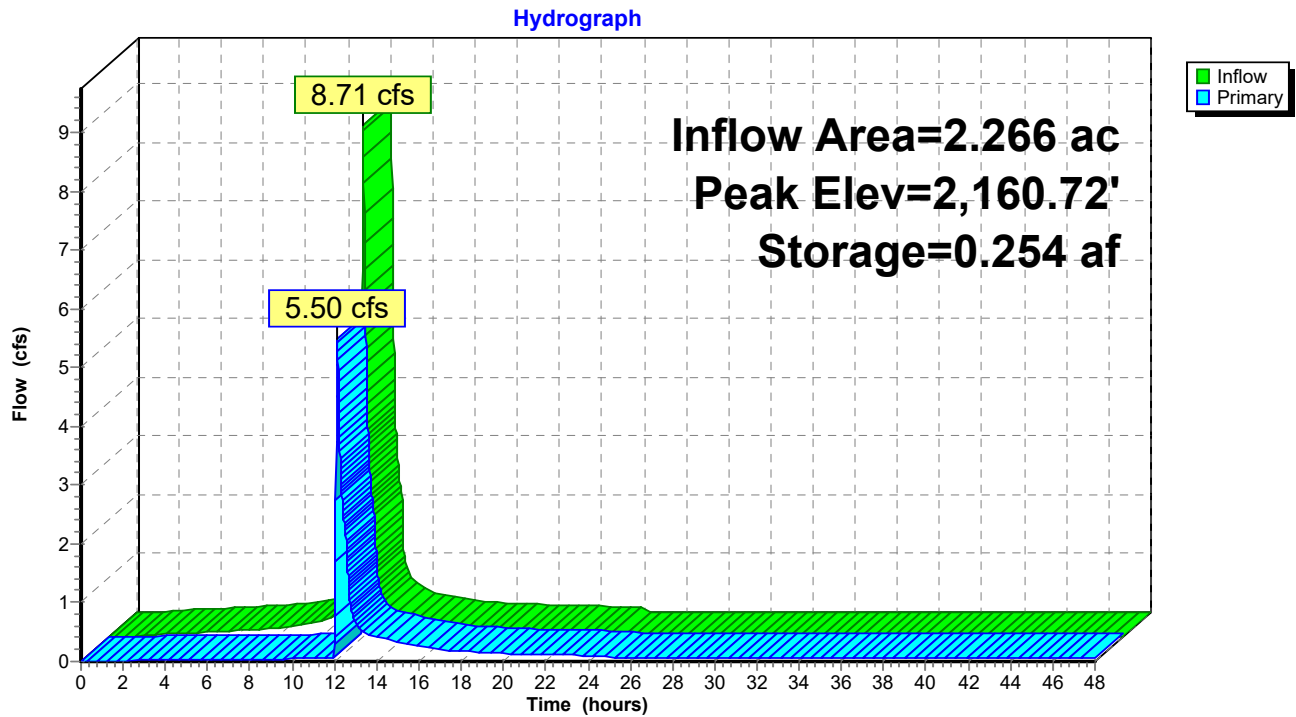Overall System Size = 182.00' x 18.00' x 5.00'

27 Chambers
606.7 cy Field
353.5 cy Stone

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Pond 2P: UNDERGROUND DETENTION SYSTEM #2

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Summary for Link 1L: POA #1

Inflow Area =   8.276 ac, Inflow Depth > 2.69"   for 10-yr event
Inflow   =   8.46 cfs @   12.59 hrs, Volume=   1.856 af
Primary   =   8.46 cfs @   12.59 hrs, Volume=   1.856 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1
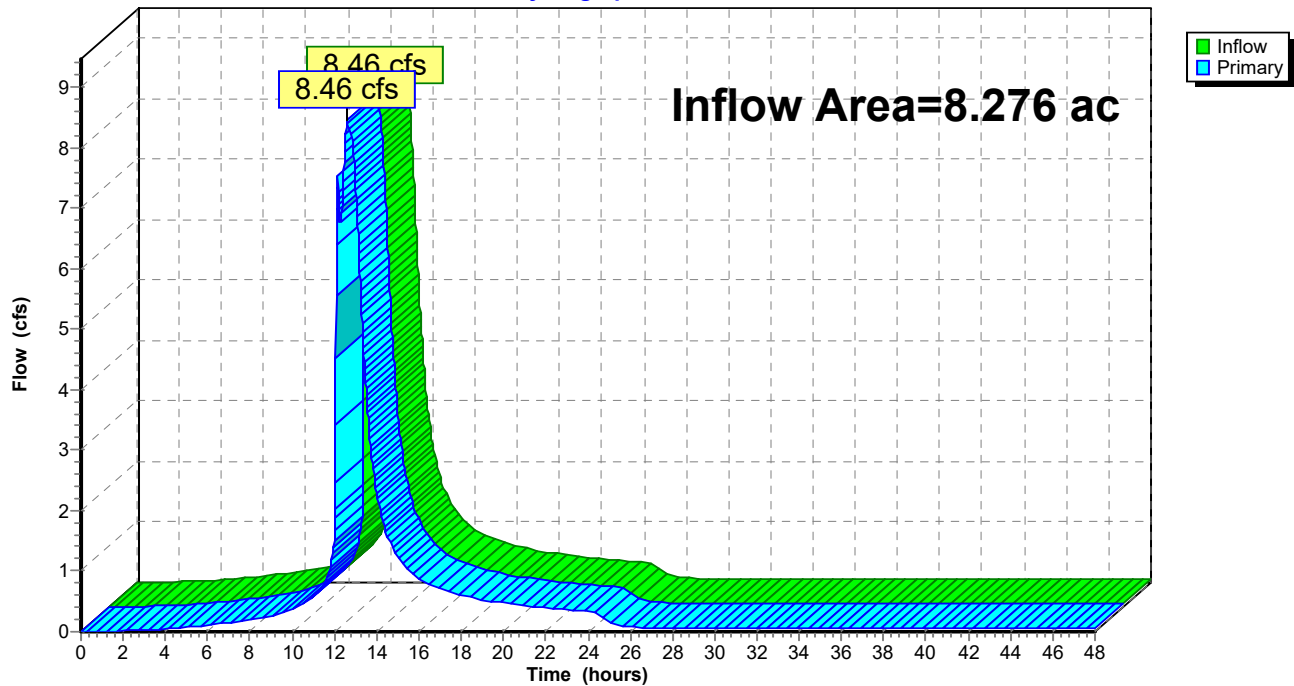
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Summary for Link 2L: MH-A

Inflow Area =   2.268 ac, Inflow Depth > 2.95"   for 10-yr event
Inflow   =   3.51 cfs @   12.20 hrs, Volume=   0.558 af
Primary   =   3.51 cfs @   12.20 hrs, Volume=   0.558 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: MH-A

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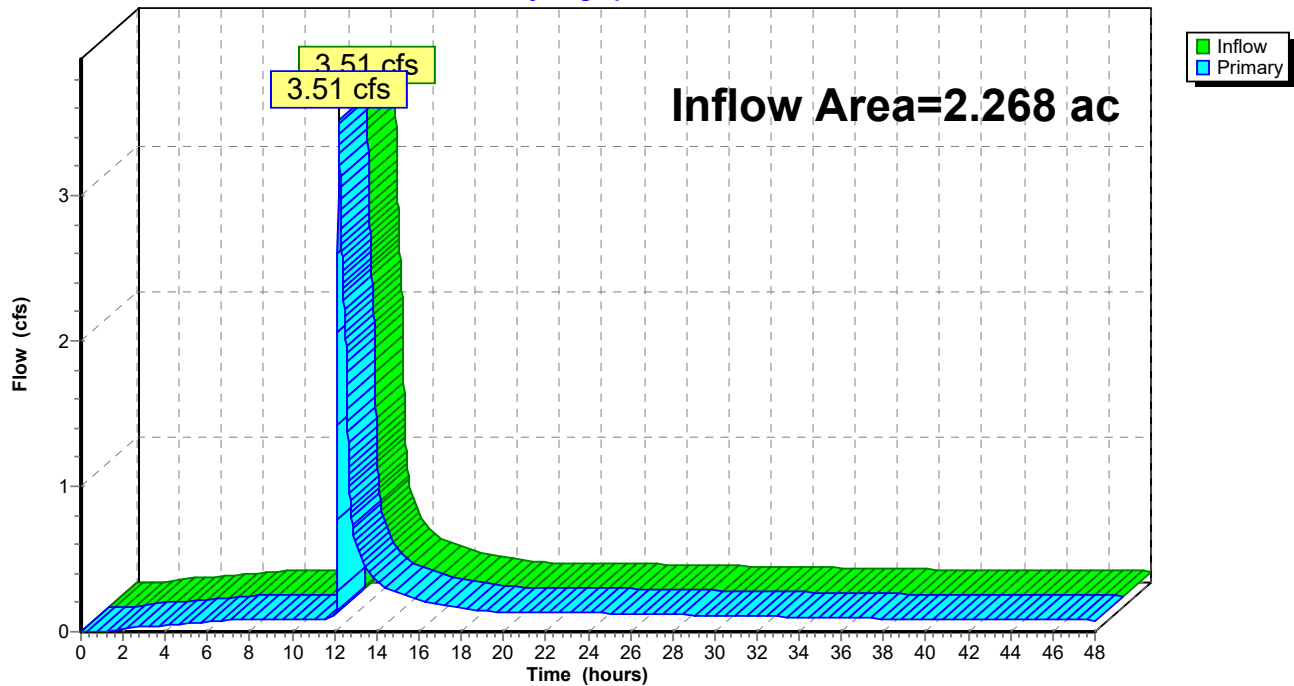
Summary for Link 3L: POA #2

Inflow Area =   9.034 ac, Inflow Depth > 3.08"   for 10-yr event
Inflow   =   26.91 cfs @   12.04 hrs, Volume=   2.316 af
Primary   =   26.91 cfs @   12.04 hrs, Volume=   2.316 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2

Hydrograph
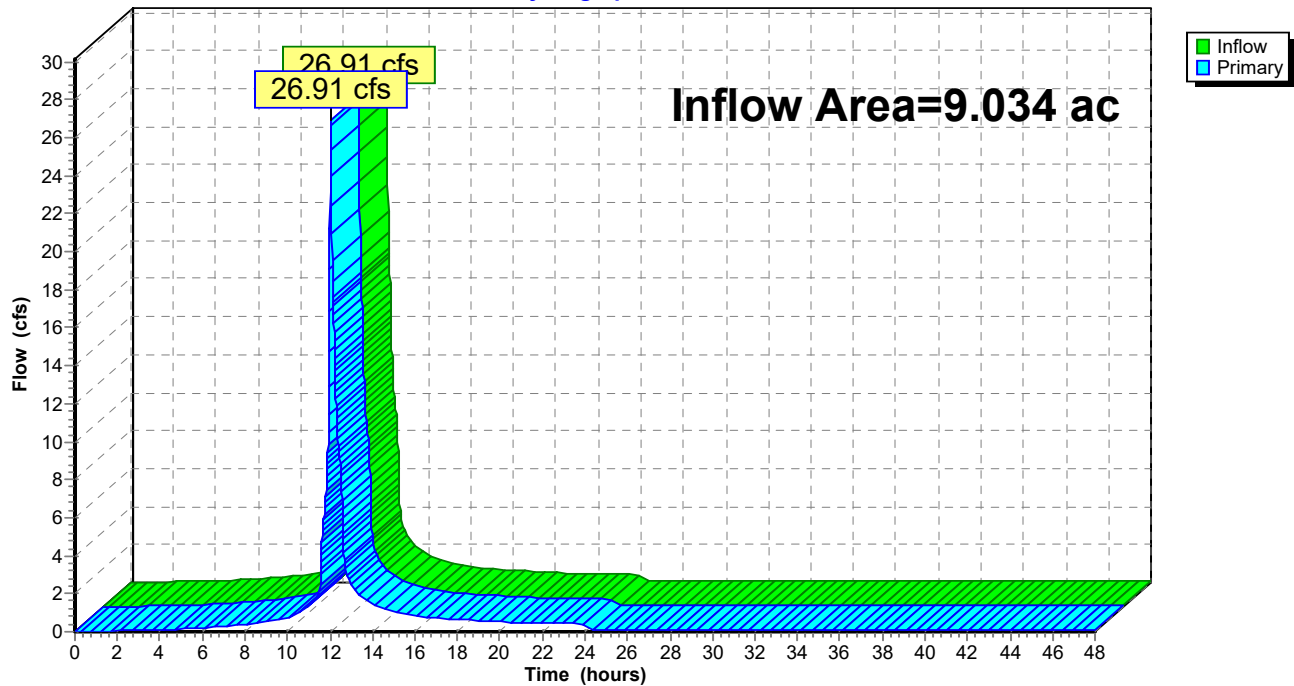
Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: BYPASS AREA   Runoff Area=6.010 ac   Runoff Depth=4.80"
                              Flow Length=973' Tc=60.9 min   CN=WQ   Runoff=12.05 cfs 2.402 af

Subcatchment 2S: DA TO DETENTION SYSTEM #1   Runoff Area=2.266 ac   Runoff Depth=5.47"
                                    Tc=6.0 min   CN=WQ   Runoff=12.43 cfs 1.033 af

Subcatchment 3S: DA TO DETENTION SYSTEM #2   Runoff Area=2.268 ac   Runoff Depth=5.17"
                                    Tc=6.0 min   CN=WQ   Runoff=11.88 cfs 0.977 af

Subcatchment 5S: BYPASS AREA   Runoff Area=6.766 ac   Runoff Depth=5.42"
                                    Tc=6.0 min   CN=WQ   Runoff=38.63 cfs 3.058 af

Pond 1P: UNDERGROUND DETENTION   Peak Elev=2,161.03' Storage=0.264 af Inflow=12.43 cfs 1.033 af
                                             Outflow=12.12 cfs 0.946 af

Pond 2P: UNDERGROUND DETENTION   Peak Elev=2,158.90' Storage=0.242 af   Inflow=11.88 cfs 0.977 af
                                             Outflow=11.63 cfs 0.963 af

Link 1L: POA #1   Inflow=15.35 cfs 3.349 af
                                             Primary=15.35 cfs 3.349 af

Link 2L: MH-A   Inflow=11.63 cfs 0.963 af
                                             Primary=11.63 cfs 0.963 af

Link 3L: POA #2   Inflow=50.06 cfs 4.020 af
                                             Primary=50.06 cfs 4.020 af

Total Runoff Area = 17.310 ac   Runoff Volume = 7.469 af   Average Runoff Depth = 5.18"

Summary for Subcatchment 1S: BYPASS AREA

Runoff   =   12.05 cfs @ 12.79 hrs, Volume=   2.402 af, Depth= 4.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.433	61	>75% Grass cover, Good, HSG B
0.407	74	>75% Grass cover, Good, HSG C
0.270	55	Woods, Good, HSG B
0.076	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.068	98	Paved parking, HSG B
0.056	98	Paved parking, HSG C
6.010		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.4	150	0.0233	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
6.7	415	0.0422	1.03		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
60.9	973	Total			

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Subcatchment 1S: BYPASS AREA

Hydrograph

VA-BLACKSBURG NOAA 100-yr
Rainfall=6.48"
Runoff Area=6.010 ac
Runoff Volume=2.402 af
Runoff Depth=4.80"
Flow Length=973'
Tc=60.9 min
CN=WQ

12.05 cfs

Runoff

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Summary for Subcatchment 2S: DA TO DETENTION SYSTEM #1

Runoff   =   12.43 cfs @ 12.04 hrs, Volume=   1.033 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
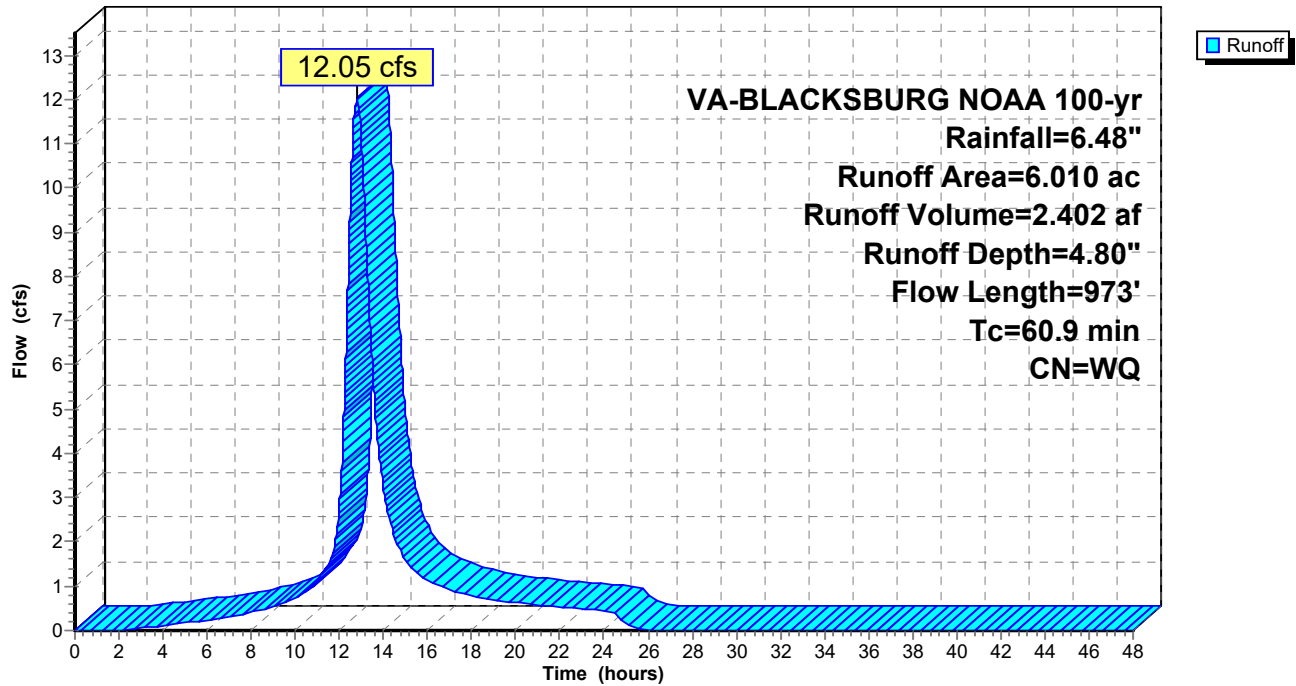VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.176	61	>75% Grass cover, Good, HSG B
0.401	74	>75% Grass cover, Good, HSG C
0.339	98	Paved parking, HSG B
1.350	98	Paved parking, HSG C
2.266		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 2S: DA TO DETENTION SYSTEM #1

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Summary for Subcatchment 3S: DA TO DETENTION SYSTEM #2

Runoff   =   11.88 cfs @ 12.04 hrs, Volume=   0.977 af, Depth= 5.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.071	61	>75% Grass cover, Good, HSG B
0.621	74	>75% Grass cover, Good, HSG C
0.064	55	Woods, Good, HSG B
0.074	70	Woods, Good, HSG C
0.135	98	Paved roads w/curbs & sewers, HSG C
0.131	98	Paved parking, HSG B
1.172	98	Paved parking, HSG C
2.268		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 3S: DA TO DETENTION SYSTEM #2

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Summary for Subcatchment 5S: BYPASS AREA

Runoff   =   38.63 cfs @ 12.04 hrs, Volume=   3.058 af, Depth= 5.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.326	85	1/8 acre lots, 65% imp, HSG B
4.878	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.384	98	Paved roads w/curbs & sewers, HSG C
6.766		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 5S: BYPASS AREA

Hydrograph

VA-BLACKSBURG NOAA 100-yr
Rainfall=6.48"
Runoff Area=6.766 ac
Runoff Volume=3.058 af
Runoff Depth=5.42"
Tc=6.0 min
CN=WQ

38.63 cfs

Summary for Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Inflow Area = 2.266 ac, Inflow Depth = 5.47" for 100-yr event
Inflow = 12.43 cfs @ 12.04 hrs, Volume= 1.033 af
Outflow = 12.12 cfs @ 12.05 hrs, Volume= 0.946 af, Atten= 2%, Lag= 0.9 min
Primary = 12.12 cfs @ 12.05 hrs, Volume= 0.946 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,161.03' @ 12.05 hrs Surf.Area= 0.083 ac Storage= 0.264 af

Plug-Flow detention time= 293.2 min calculated for 0.946 af (92% of inflow)
Center-of-Mass det. time= 245.7 min (1,004.6 - 758.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,156.25'	0.097 af	**18.00'W x 202.00'L x 5.00'H Field A**
			0.417 af Overall - 0.174 af Embedded = 0.243 af x 40.0% Voids
#2A	2,156.75'	0.174 af	**CMP Round 48 x 30 Inside #1**
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.271 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,156.07'	**18.0" Round 18" HDPE**
			L= 82.4' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,156.07' / 2,155.51' S= 0.0068 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.77 sf
#2	Device 1	2,156.07'	**1.2" Vert. 1" Orifice** C= 0.600
#3	Device 1	2,159.75'	**5.0" Vert. 3" Orifice** C= 0.600
#4	Device 1	2,160.25'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=12.09 cfs @ 12.05 hrs HW=2,161.03' (Free Discharge)
└─**1=18" HDPE** (Passes 12.09 cfs of 17.46 cfs potential flow)
 ├─**2=1" Orifice** (Orifice Controls 0.08 cfs @ 10.67 fps)
 ├─**3=3" Orifice** (Orifice Controls 0.68 cfs @ 4.99 fps)
 └─**4=Broad-Crested Rectangular Weir** (Weir Controls 11.33 cfs @ 2.90 fps)

Pond 1P: UNDERGROUND DETENTION SYSTEM #1 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

10 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 200.00' Row Length +12.0"
End Stone x 2 = 202.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

30 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
7,590.1 cf Chamber Storage

18,180.0 cf Field - 7,590.1 cf Chambers = 10,589.9 cf Stone x 40.0% Voids = 4,236.0 cf Stone Storage

Chamber Storage + Stone Storage = 11,826.1 cf = 0.271 af
Overall Storage Efficiency = 65.0%
Overall System Size = 202.00' x 18.00' x 5.00'

30 Chambers
673.3 cy Field
392.2 cy Stone

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Pond 1P: UNDERGROUND DETENTION SYSTEM #1

Hydrograph

Inflow
Primary

12.43 cfs
12.12 cfs

Inflow Area=2.266 ac
Peak Elev=2,161.03'
Storage=0.264 af

Summary for Pond 2P: UNDERGROUND DETENTION SYSTEM #2

Inflow Area =   2.268 ac, Inflow Depth = 5.17"   for 100-yr event
Inflow   =   11.88 cfs @ 12.04 hrs, Volume=   0.977 af
Outflow   =   11.63 cfs @ 12.05 hrs, Volume=   0.963 af, Atten= 2%, Lag= 0.8 min
Primary   =   11.63 cfs @ 12.05 hrs, Volume=   0.963 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2,158.90' @ 12.05 hrs   Surf.Area= 0.075 ac   Storage= 0.242 af

Plug-Flow detention time= 323.1 min calculated for 0.963 af (99% of inflow)
Center-of-Mass det. time= 313.5 min (1,080.3 - 766.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	2,154.00'	0.088 af	**18.00'W x 182.00'L x 5.00'H Field A**
			0.376 af Overall - 0.157 af Embedded = 0.219 af x 40.0% Voids
#2A	2,154.50'	0.157 af	**CMP Round 48 x 27 Inside #1**
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			Row Length Adjustment= -4.00' x 12.57 sf x 3 rows
			16.00' Header x 12.57 sf x 1 = 201.1 cf Inside
		0.245 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	2,153.85'	**15.0" Round 15" HDPE**
			L= 37.1' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 2,153.85' / 2,153.55' S= 0.0081 '/' Cc= 0.900
			n= 0.011, Flow Area= 1.23 sf
#2	Device 1	2,153.85'	**Reg-U-Flo SXH 3.0-in**
#3	Device 1	2,158.00'	**8.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	2,158.15'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=11.61 cfs @ 12.05 hrs HW=2,158.90'   (Free Discharge)
└—**1=15" HDPE** (Passes 11.61 cfs of 12.43 cfs potential flow)
  ├—**2=Reg-U-Flo SXH 3.0-in** (Custom Controls 0.15 cfs)
  ├—**3=Orifice/Grate** (Orifice Controls 0.91 cfs @ 4.12 fps)
  └—**4=Broad-Crested Rectangular Weir** (Weir Controls 10.55 cfs @ 2.81 fps)

Pond 2P: UNDERGROUND DETENTION SYSTEM #2 - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= -4.00' x 12.57 sf x 3 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

9 Chambers/Row x 20.00' Long -4.00' Row Adjustment +4.00' Header x 1 = 180.00' Row Length +12.0"
End Stone x 2 = 182.00' Base Length
3 Rows x 48.0" Wide + 24.0" Spacing x 2 + 12.0" Side Stone x 2 = 18.00' Base Width
6.0" Base + 48.0" Chamber Height + 6.0" Cover = 5.00' Field Height

27 Chambers x 251.3 cf -4.00' Row Adjustment x 12.57 sf x 3 Rows + 16.00' Header x 12.57 sf =
6,836.1 cf Chamber Storage

16,380.0 cf Field - 6,836.1 cf Chambers = 9,543.9 cf Stone x 40.0% Voids = 3,817.6 cf Stone Storage

Chamber Storage + Stone Storage = 10,653.7 cf = 0.245 af
Overall Storage Efficiency = 65.0%
Overall System Size = 182.00' x 18.00' x 5.00'

27 Chambers
606.7 cy Field
353.5 cy Stone

POST DEV
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VA-BLACKSBURG NOAA 100-yr Rainfall=6.48"
Printed 8/1/2018
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Pond 2P: UNDERGROUND DETENTION SYSTEM #2

Hydrograph

Inflow Area=2.268 ac
Peak Elev=2,158.90'
Storage=0.242 af

Summary for Link 1L: POA #1

Inflow Area =   8.276 ac, Inflow Depth > 4.86" for 100-yr event
Inflow   =   15.35 cfs @ 12.06 hrs, Volume=   3.349 af
Primary   =   15.35 cfs @ 12.06 hrs, Volume=   3.349 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: POA #1
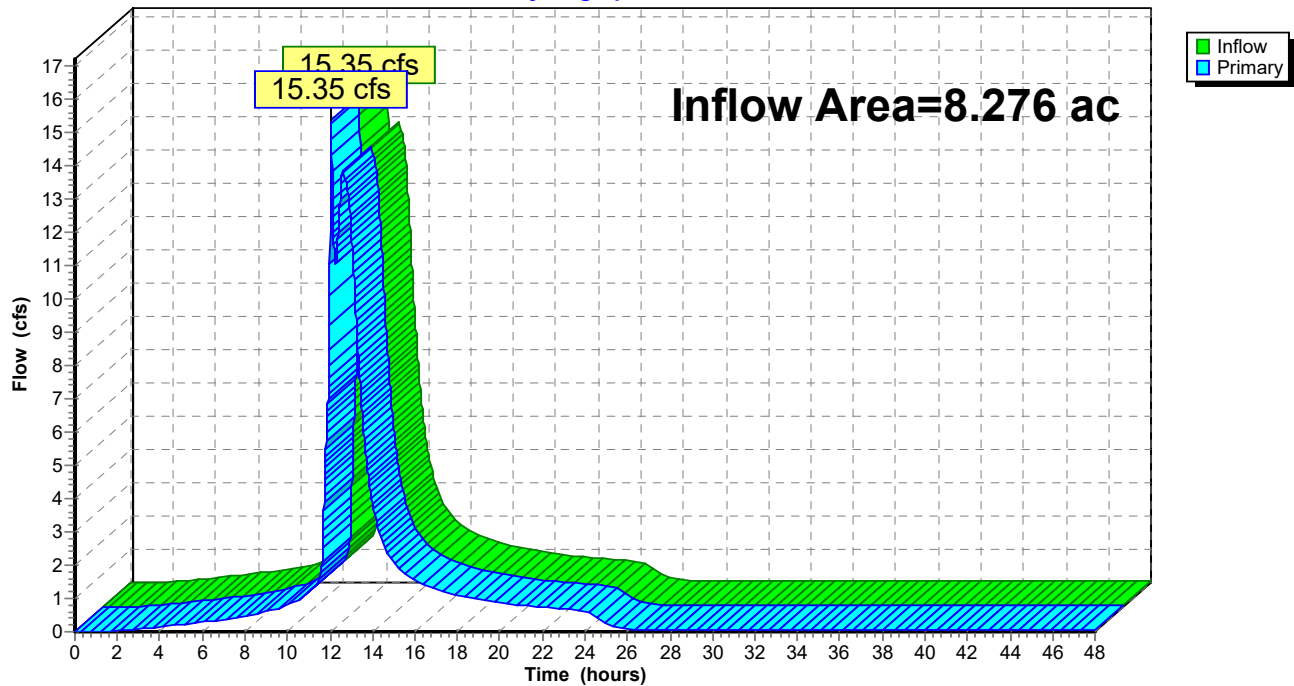
Summary for Link 2L: MH-A

Inflow Area =   2.268 ac, Inflow Depth > 5.09"   for 100-yr event
Inflow   =   11.63 cfs @   12.05 hrs, Volume=   0.963 af
Primary   =   11.63 cfs @   12.05 hrs, Volume=   0.963 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: MH-A
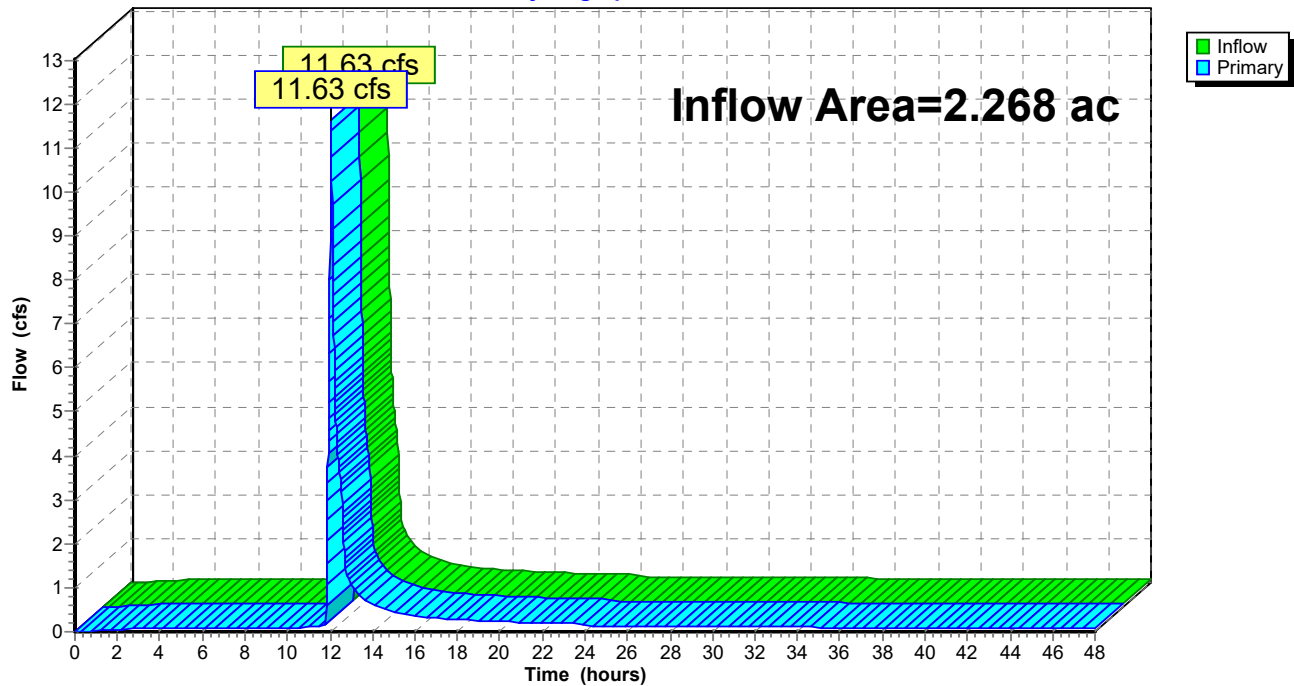
Summary for Link 3L: POA #2

Inflow Area =   9.034 ac, Inflow Depth > 5.34"   for 100-yr event
Inflow   =   50.06 cfs @   12.04 hrs, Volume=   4.020 af
Primary   =   50.06 cfs @   12.04 hrs, Volume=   4.020 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: POA #2

3S

DA #2 - ON SITE

5S

3L

OFF SITE AREA
DRAINING TO EX DI-1

ENERGY BALANCE
MAX Q REDUCTION

6S

ONSITE AREA
BYPASSING EX DI-1

1S

4L

DA #1 - ON SITE

EX DI-1

8L

2S

1L

ENERGY BALANCE
MAX Q REDUCTION

DA #1 - OFFSITE

ENERGY BALANCE
MAX Q REDUCTION

2L

5L

7S

DA #1

POA #2

OFFSITE AREA
BYPASSING EX DI-1

Subcat   Reach   Pond   Link

Routing Diagram for CHANNEL PROTECTION
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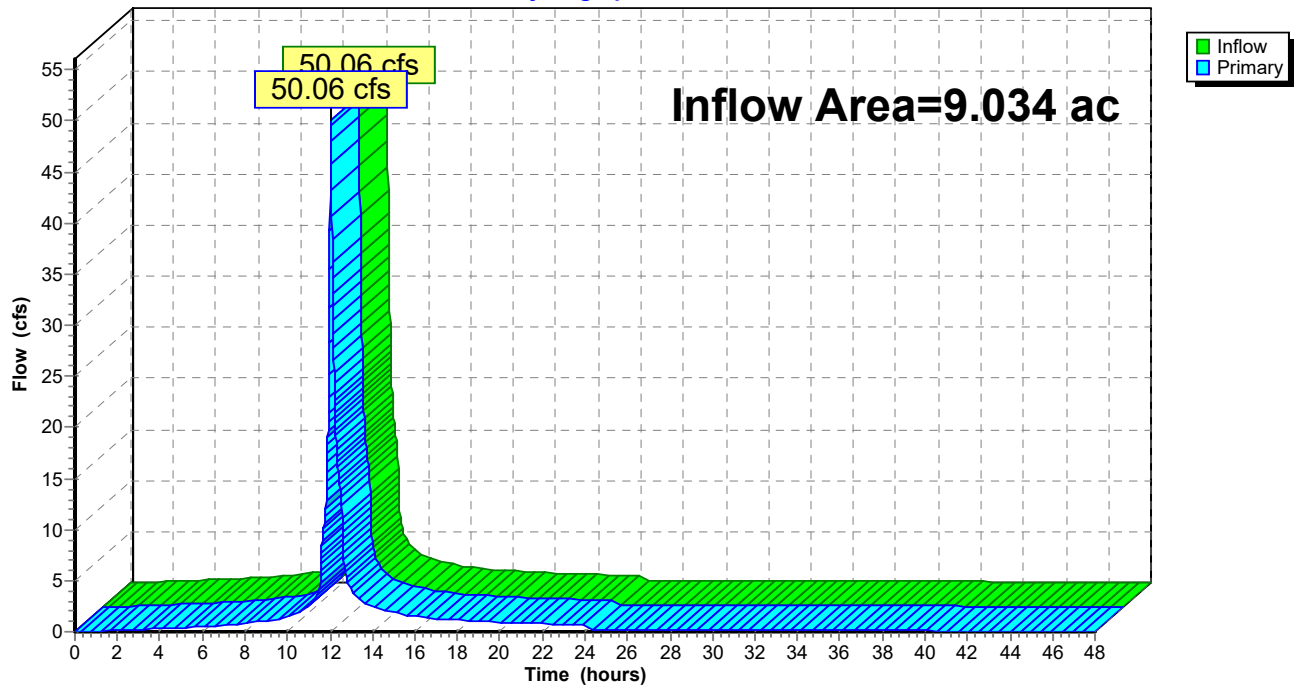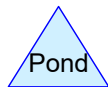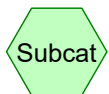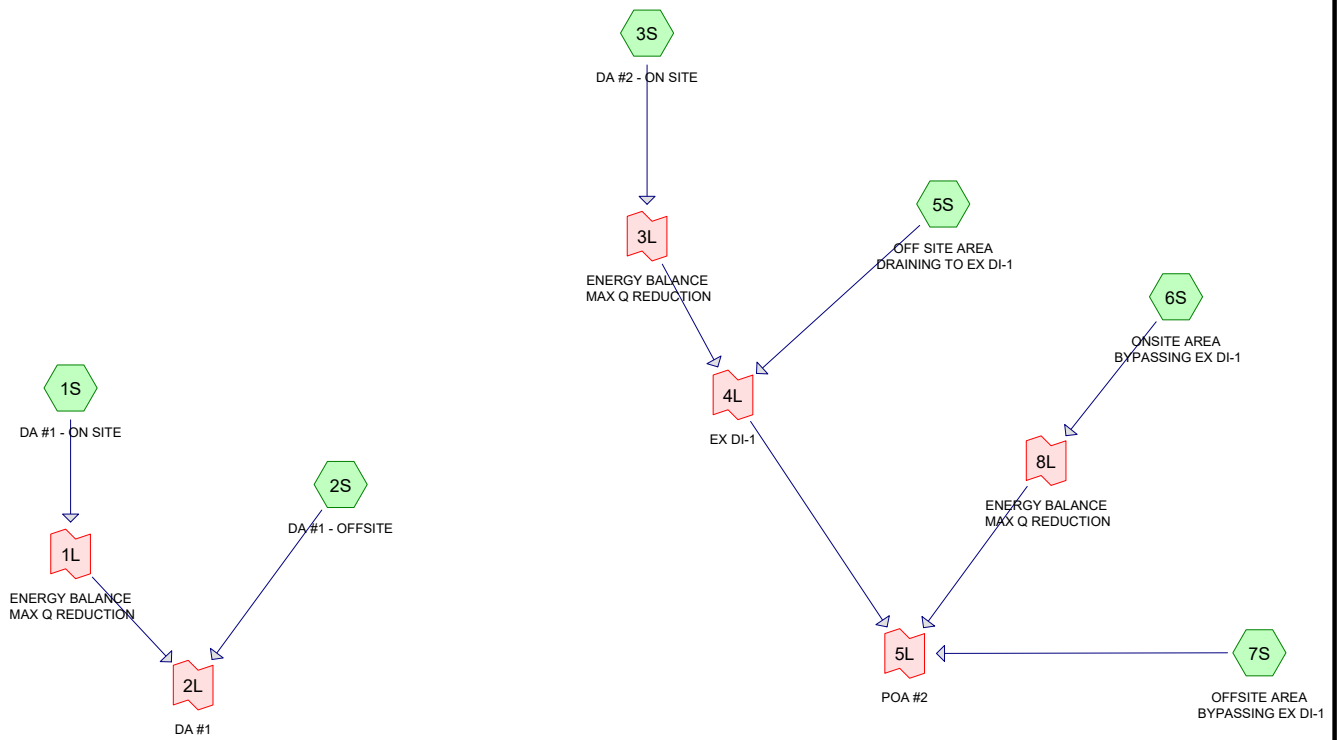
Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: DA #1 - ON SITE   Runoff Area=2.018 ac   Runoff Depth=0.40"
                              Flow Length=998' Tc=58.8 min   CN=WQ   Runoff=0.33 cfs 0.068 af

Subcatchment 2S: DA #1 - OFFSITE   Runoff Area=5.979 ac   Runoff Depth=1.16"
                              Flow Length=998' Tc=58.8 min   CN=WQ   Runoff=3.36 cfs 0.580 af

Subcatchment 3S: DA #2 - ON SITE   Runoff Area=2.083 ac   Runoff Depth=0.62"
                              Flow Length=285' Tc=22.7 min   CN=WQ   Runoff=0.87 cfs 0.108 af

Subcatchment 5S: OFF SITE AREA DRAINING TO EX DI-1   Runoff Area=0.155 ac   Runoff Depth=1.29"
                              Flow Length=285' Tc=22.7 min   CN=WQ   Runoff=0.15 cfs 0.017 af

Subcatchment 6S: ONSITE AREA BYPASSING EX DI-1   Runoff Area=0.354 ac   Runoff Depth=0.87"
                                       Tc=6.0 min   CN=WQ   Runoff=0.43 cfs 0.026 af

Subcatchment 7S: OFFSITE AREA BYPASSING EX DI-1   Runoff Area=6.750 ac   Runoff Depth=1.43"
                                       Tc=6.0 min   CN=WQ   Runoff=13.63 cfs 0.806 af

Link 1L: ENERGY BALANCE MAX Q REDUCTION   x 0.18   Inflow=0.33 cfs 0.068 af
                          Primary=0.06 cfs 0.012 af Secondary=0.27 cfs 0.056 af

Link 2L: DA #1   Inflow=3.41 cfs 0.592 af
                                                          Primary=3.41 cfs 0.592 af

Link 3L: ENERGY BALANCE MAX Q REDUCTION   x 0.34   Inflow=0.87 cfs 0.108 af
                          Primary=0.29 cfs 0.037 af Secondary=0.57 cfs 0.072 af

Link 4L: EX DI-1   Inflow=0.44 cfs 0.053 af
                                                          Primary=0.44 cfs 0.053 af

Link 5L: POA #2   Inflow=13.94 cfs 0.868 af
                                                          Primary=13.94 cfs 0.868 af

Link 8L: ENERGY BALANCE MAX Q REDUCTION   x 0.34   Inflow=0.43 cfs 0.026 af
                          Primary=0.14 cfs 0.009 af Secondary=0.28 cfs 0.017 af

Total Runoff Area = 17.339 ac   Runoff Volume = 1.604 af   Average Runoff Depth = 1.11"

Summary for Subcatchment 1S: DA #1 - ON SITE

Runoff   =   0.33 cfs @ 12.87 hrs, Volume=   0.068 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.081	61	>75% Grass cover, Good, HSG B
1.103	74	>75% Grass cover, Good, HSG C
0.541	55	Woods, Good, HSG B
0.207	70	Woods, Good, HSG C
0.036	98	Paved parking, HSG B
0.050	98	Paved parking, HSG C
2.018		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.6	150	0.0267	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
7.4	440	0.0398	1.00		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0564	3.82		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
58.8	998				Total

Subcatchment 1S: DA #1 - ON SITE

Hydrograph

Summary for Subcatchment 2S: DA #1 - OFFSITE

Runoff   =   3.36 cfs @ 12.74 hrs, Volume=   0.580 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
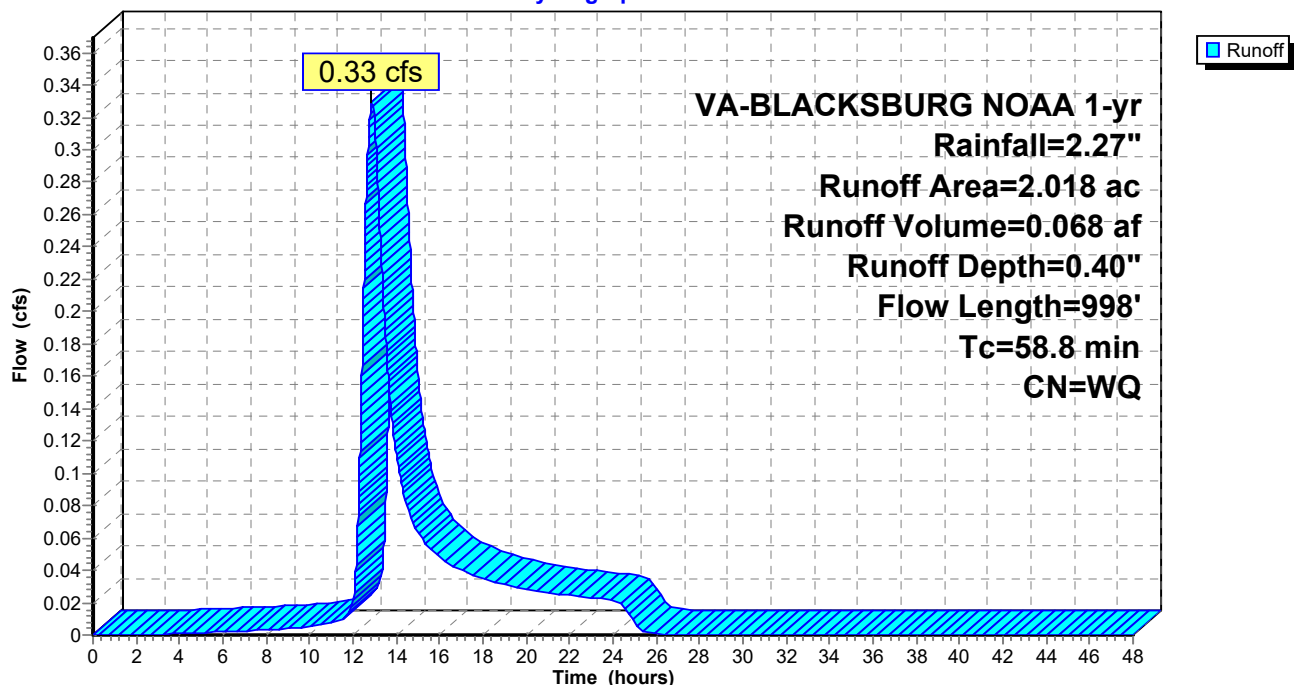VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.370	61	>75% Grass cover, Good, HSG B
0.330	74	>75% Grass cover, Good, HSG C
0.382	55	Woods, Good, HSG B
0.078	70	Woods, Good, HSG C
0.164	70	1/2 acre lots, 25% imp, HSG B
0.371	80	1/2 acre lots, 25% imp, HSG C
0.282	75	1/4 acre lots, 38% imp, HSG B
0.496	83	1/4 acre lots, 38% imp, HSG C
0.044	85	1/8 acre lots, 65% imp, HSG B
0.685	92	Urban commercial, 85% imp, HSG B
2.402	94	Urban commercial, 85% imp, HSG C
0.047	98	Paved roads w/curbs & sewers, HSG B
0.209	98	Paved roads w/curbs & sewers, HSG C
0.068	98	Paved parking, HSG B
0.051	98	Paved parking, HSG C
5.979		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.6	150	0.0267	0.05		**Sheet Flow, Tc1**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
7.4	440	0.0398	1.00		**Shallow Concentrated Flow, Tc2**
					Woodland Kv= 5.0 fps
1.8	408	0.0560	3.81		**Shallow Concentrated Flow, Tc3**
					Unpaved Kv= 16.1 fps
58.8	998				Total

CHANNEL PROTECTION
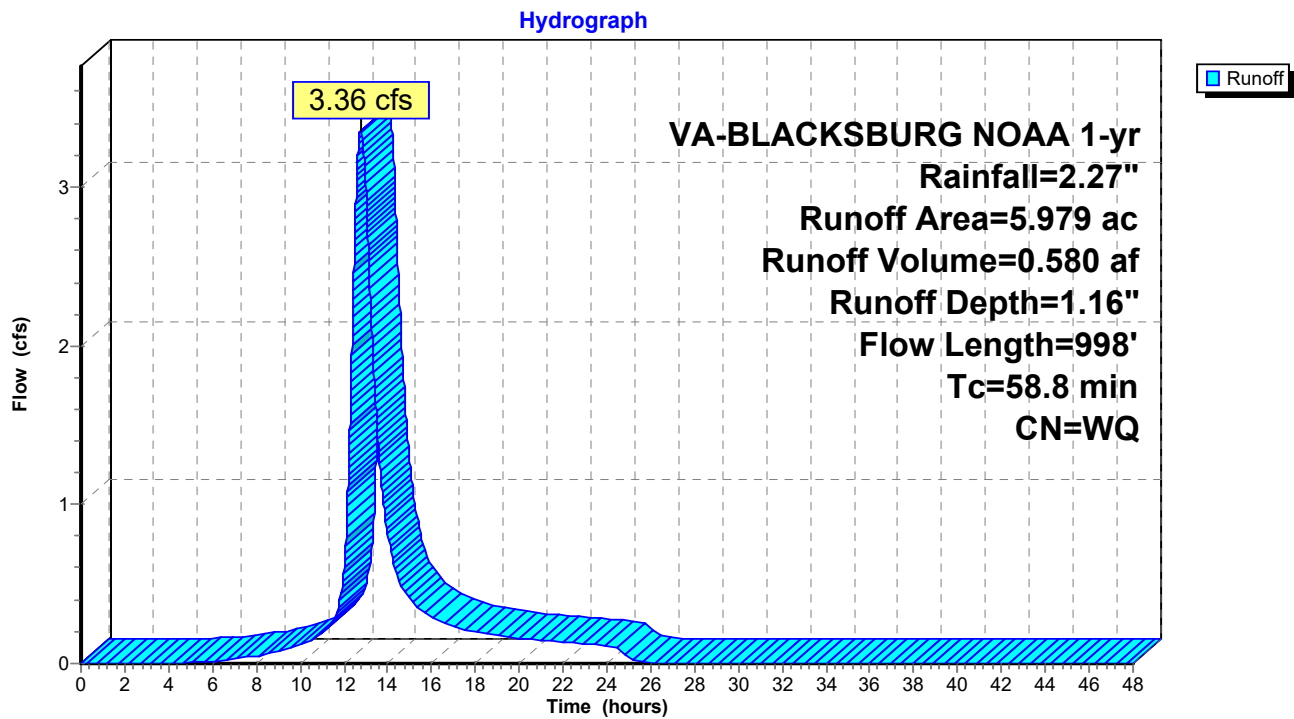Prepared by Balzer & Associates, Inc.
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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
Printed 8/1/2018
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Subcatchment 2S: DA #1 - OFFSITE

Hydrograph

VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=5.979 ac
Runoff Volume=0.580 af
Runoff Depth=1.16"
Flow Length=998'
Tc=58.8 min
CN=WQ

3.36 cfs

☐ Runoff

CHANNEL PROTECTION
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VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
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Summary for Subcatchment 3S: DA #2 - ON SITE

Runoff   =   0.87 cfs @   12.30 hrs, Volume=   0.108 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.944	74	>75% Grass cover, Good, HSG C
0.005	55	Woods, Good, HSG B
0.870	70	Woods, Good, HSG C
0.264	98	Paved parking, HSG C
2.083		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	60	0.0333	0.05		**Sheet Flow, Tc4**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
0.9	225	0.0711	4.29		**Shallow Concentrated Flow, Tc5**
					Unpaved Kv= 16.1 fps
22.7	285	Total			

Subcatchment 3S: DA #2 - ON SITE

Hydrograph

VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=2.083 ac
Runoff Volume=0.108 af
Runoff Depth=0.62"
Flow Length=285'
Tc=22.7 min
CN=WQ

0.87 cfs

Summary for Subcatchment 5S: OFF SITE AREA DRAINING TO EX DI-1

Runoff   =   0.15 cfs @   12.27 hrs, Volume=   0.017 af, Depth= 1.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
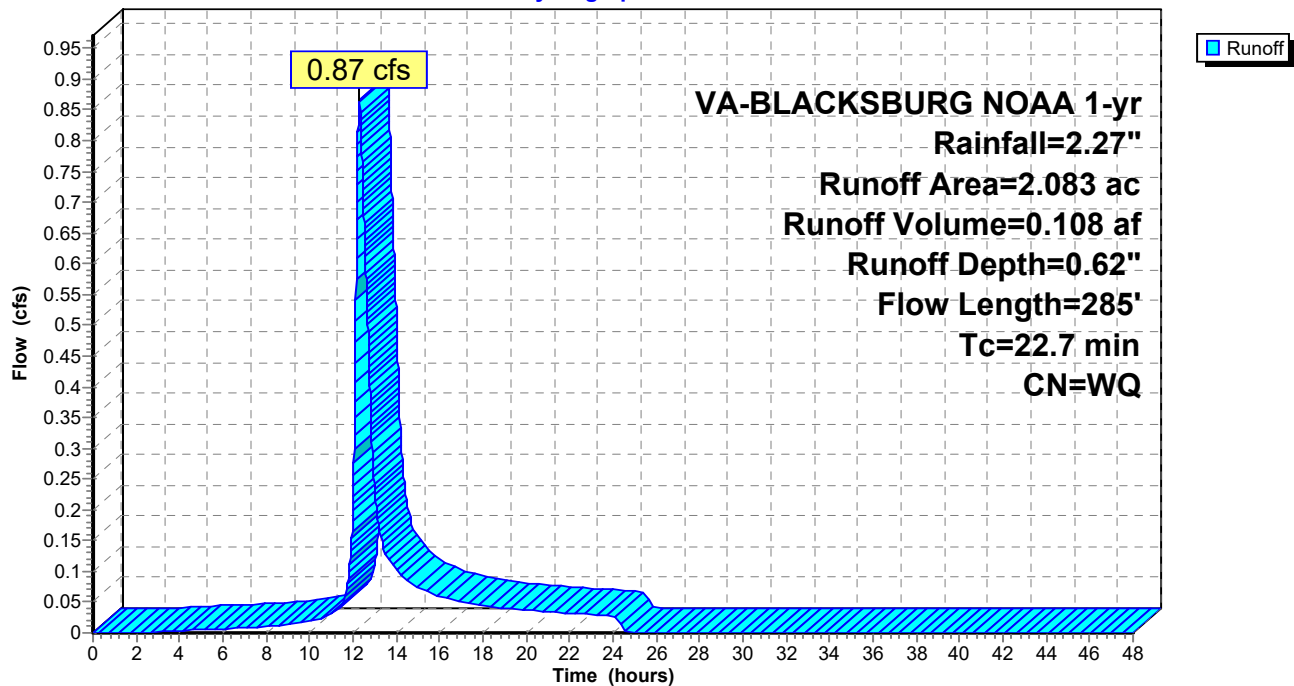VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.073	74	>75% Grass cover, Good, HSG C
0.002	70	Woods, Good, HSG C
0.080	98	Paved parking, HSG C
0.155		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	60	0.0333	0.05		**Sheet Flow, Tc4**
					Woods: Dense underbrush n= 0.800 P2= 2.76"
0.9	225	0.0711	4.29		**Shallow Concentrated Flow, Tc5**
					Unpaved Kv= 16.1 fps
22.7	285	Total			

Subcatchment 5S: OFF SITE AREA DRAINING TO EX DI-1

Summary for Subcatchment 6S: ONSITE AREA BYPASSING EX DI-1

Runoff   =   0.43 cfs @   12.04 hrs, Volume=   0.026 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
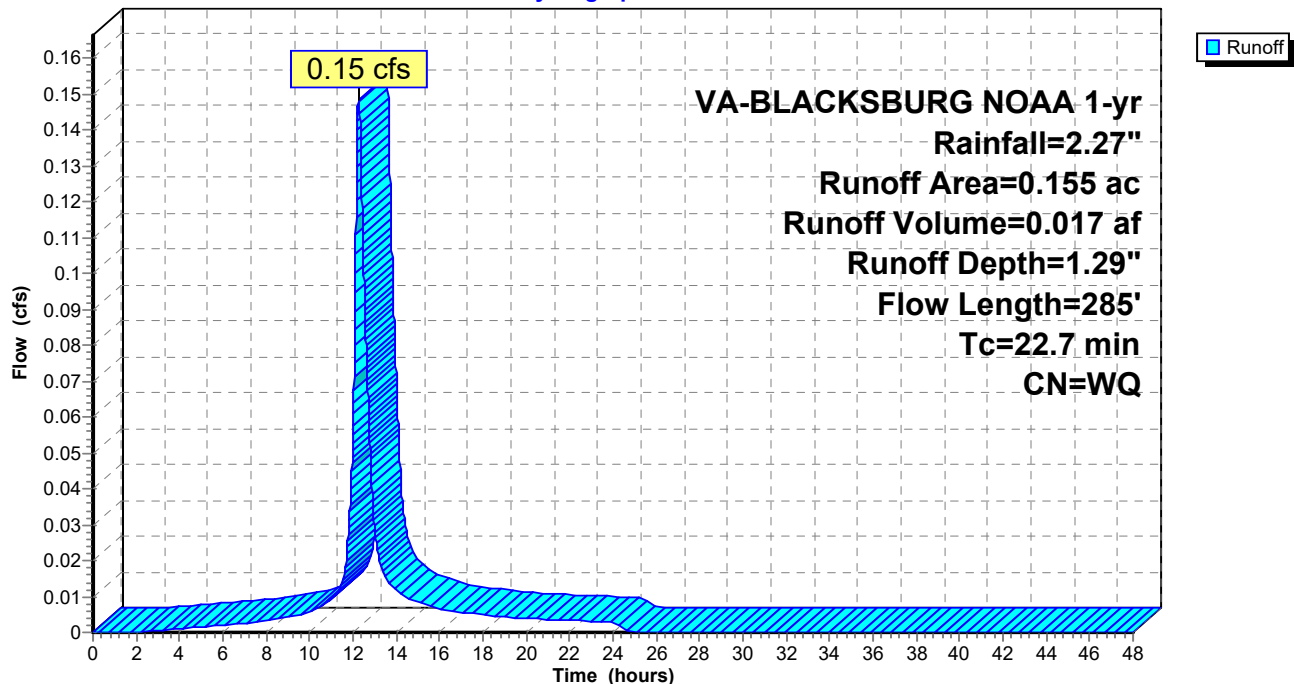VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.068	70	Woods, Good, HSG C
0.286	85	1/8 acre lots, 65% imp, HSG B
0.354		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 6S: ONSITE AREA BYPASSING EX DI-1

Summary for Subcatchment 7S: OFFSITE AREA BYPASSING EX DI-1

Runoff   =   13.63 cfs @ 12.04 hrs, Volume=   0.806 af, Depth= 1.43"
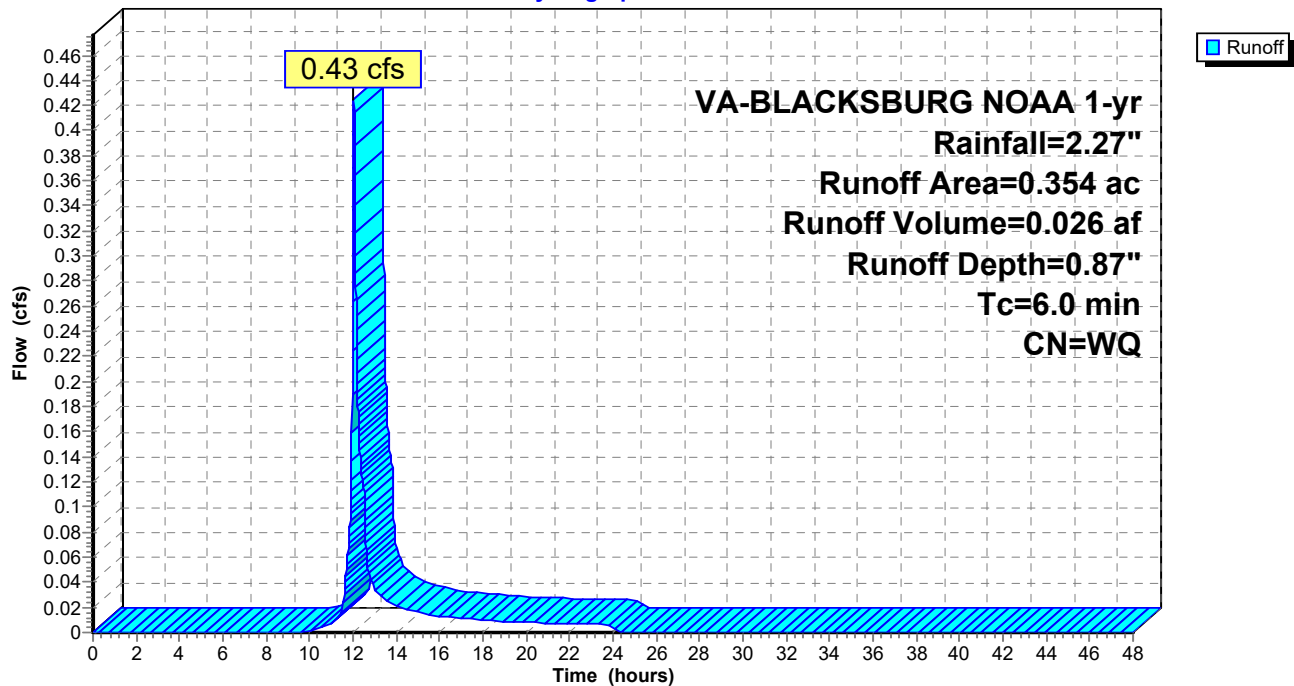
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"

Area (ac)	CN	Description
0.106	61	>75% Grass cover, Good, HSG B
0.044	74	>75% Grass cover, Good, HSG C
0.009	55	Woods, Good, HSG B
0.326	85	1/8 acre lots, 65% imp, HSG B
4.881	90	1/8 acre lots, 65% imp, HSG C
0.028	98	Paved roads w/curbs & sewers, HSG B
1.356	98	Paved parking, HSG C
6.750		Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, DIRECT**

Subcatchment 7S: OFFSITE AREA BYPASSING EX DI-1

Hydrograph

VA-BLACKSBURG NOAA 1-yr
Rainfall=2.27"
Runoff Area=6.750 ac
Runoff Volume=0.806 af
Runoff Depth=1.43"
Tc=6.0 min
CN=WQ

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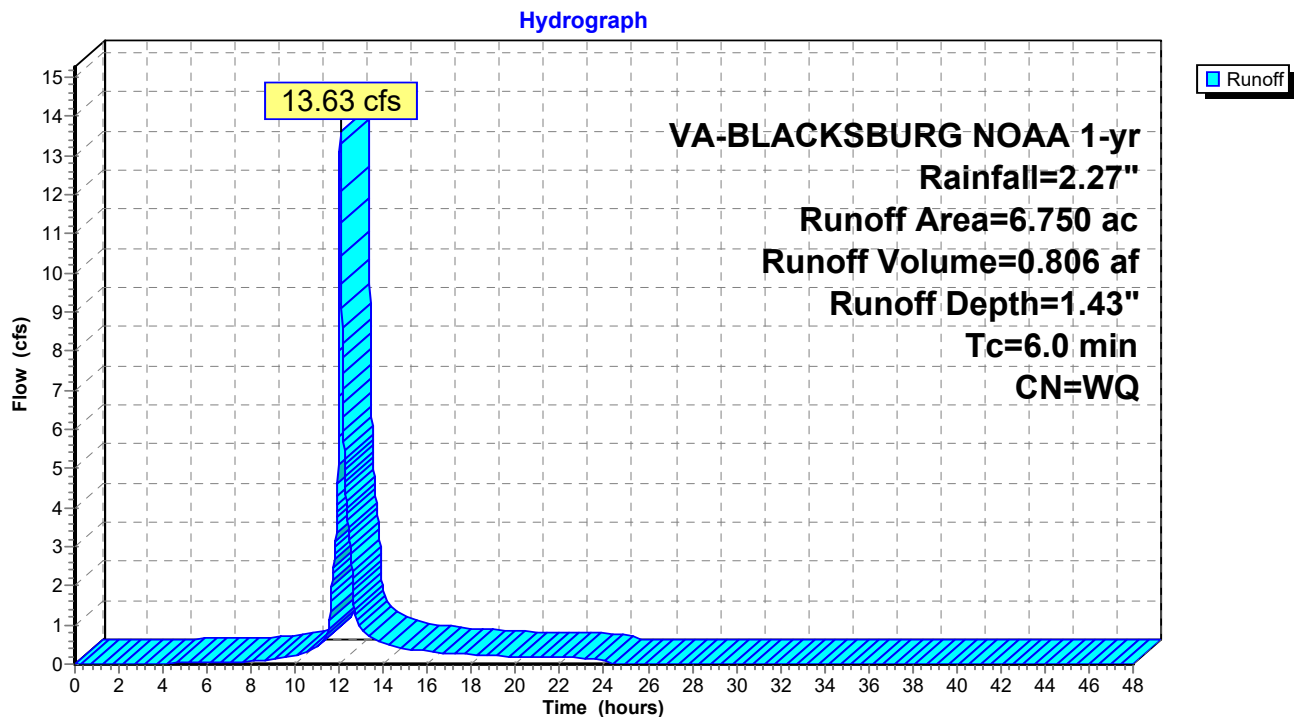*VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"*
Printed 8/1/2018
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Summary for Link 1L: ENERGY BALANCE MAX Q REDUCTION

Inflow Area =   2.018 ac, Inflow Depth =   0.40"   for 1-yr event
Inflow   =   0.33 cfs @   12.87 hrs, Volume=   0.068 af
Primary   =   0.06 cfs @   12.87 hrs, Volume=   0.012 af, Atten= 82%, Lag= 0.0 min
Secondary =   0.27 cfs @   12.87 hrs, Volume=   0.056 af

Primary outflow = Inflow x 0.18, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: ENERGY BALANCE MAX Q REDUCTION

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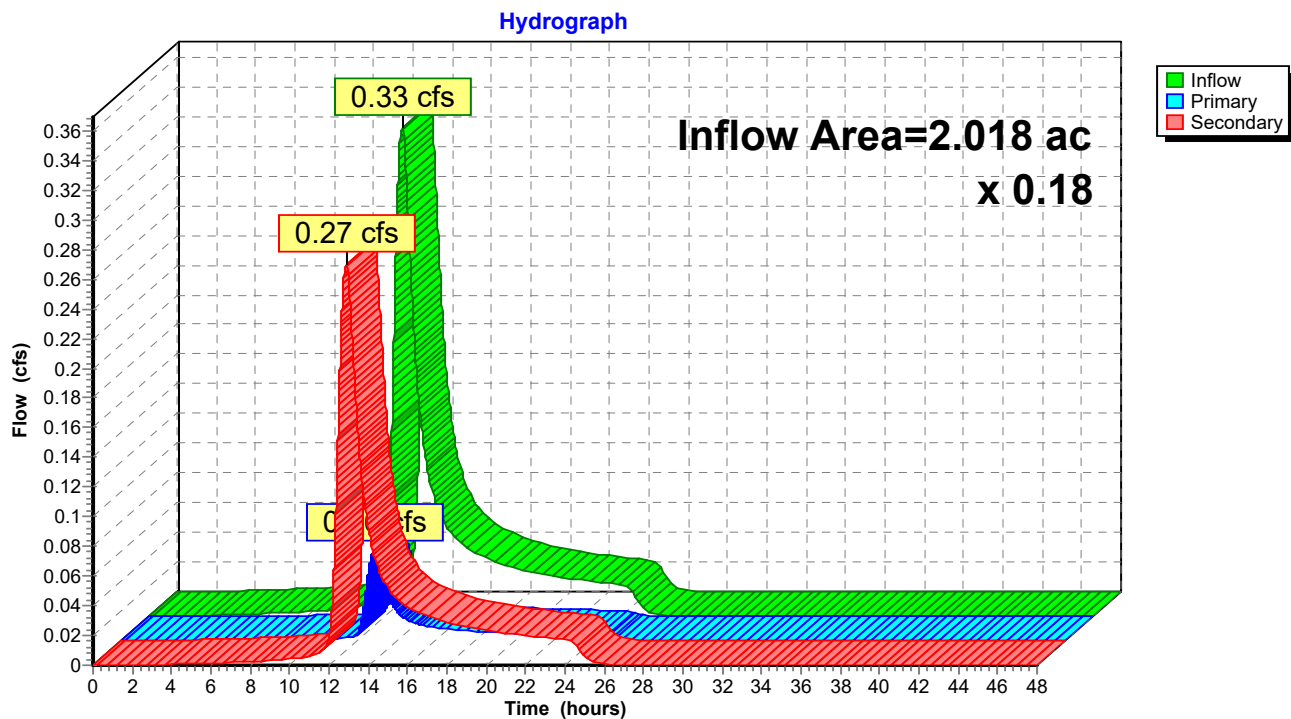*VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"*
Printed 8/1/2018
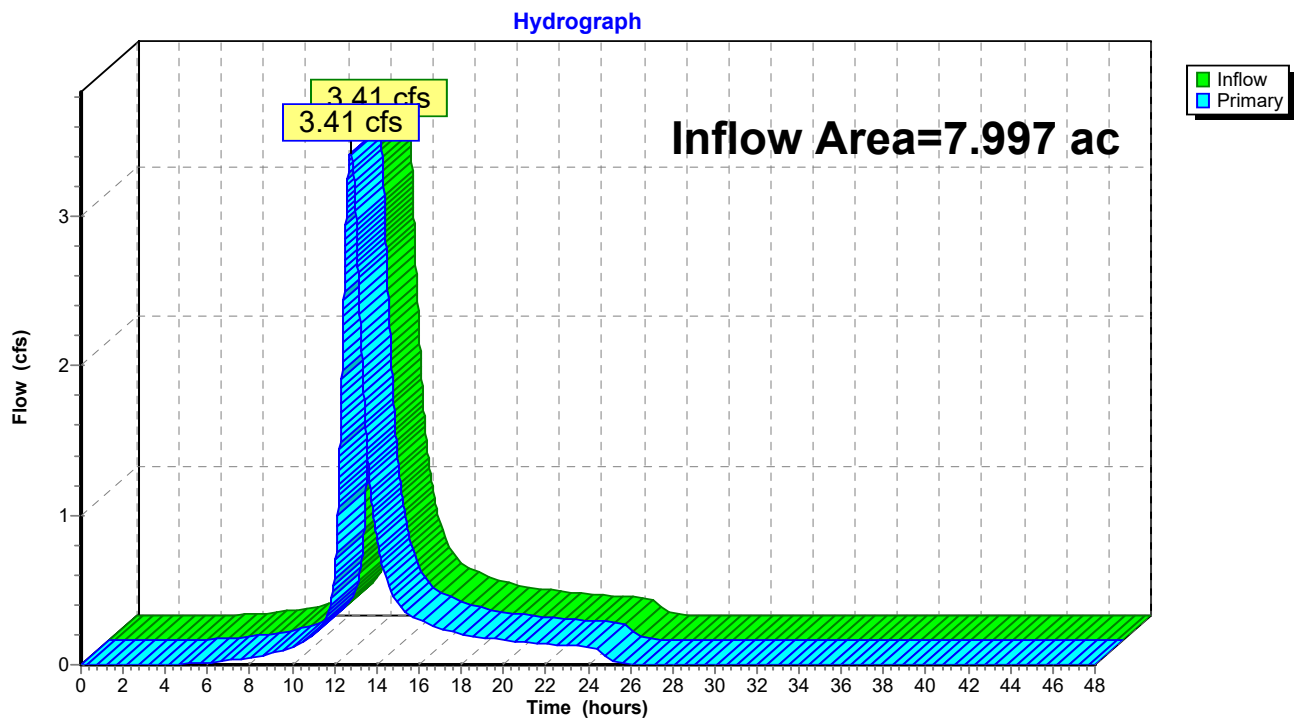Page 11

Summary for Link 2L: DA #1

Inflow Area =   7.997 ac, Inflow Depth =   0.89"   for 1-yr event
Inflow   =   3.41 cfs @   12.74 hrs, Volume=   0.592 af
Primary   =   3.41 cfs @   12.74 hrs, Volume=   0.592 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: DA #1

Hydrograph

CHANNEL PROTECTION
VA-BLACKSBURG NOAA 1-yr Rainfall=2.27"
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Summary for Link 3L: ENERGY BALANCE MAX Q REDUCTION

Inflow Area = 2.083 ac, Inflow Depth = 0.62" for 1-yr event
Inflow = 0.87 cfs @ 12.30 hrs, Volume= 0.108 af
Primary = 0.29 cfs @ 12.30 hrs, Volume= 0.037 af, Atten= 66%, Lag= 0.0 min
Secondary = 0.57 cfs @ 12.30 hrs, Volume= 0.072 af

Primary outflow = Inflow x 0.34, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 3L: ENERGY BALANCE MAX Q REDUCTION
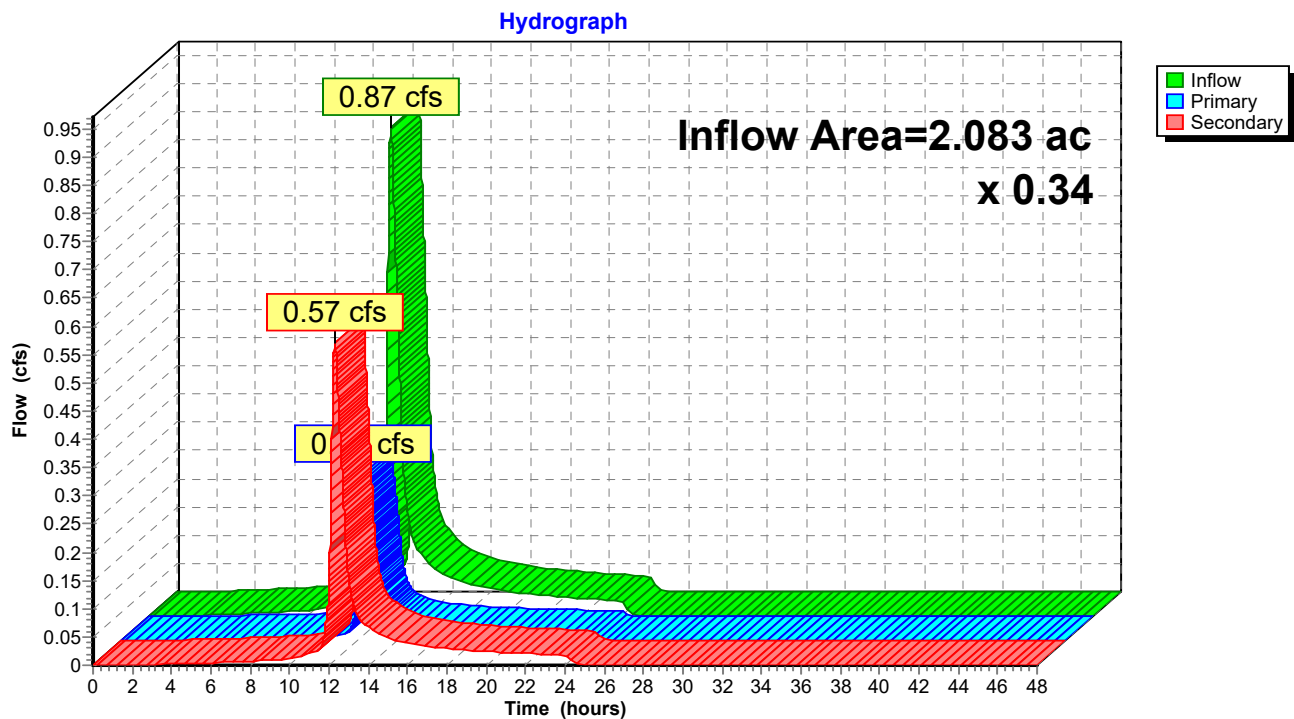
Summary for Link 4L: EX DI-1

Inflow Area =   2.238 ac, Inflow Depth =   0.29"   for 1-yr event
Inflow   =   0.44 cfs @   12.29 hrs, Volume=   0.053 af
Primary   =   0.44 cfs @   12.29 hrs, Volume=   0.053 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 4L: EX DI-1

Hydrograph
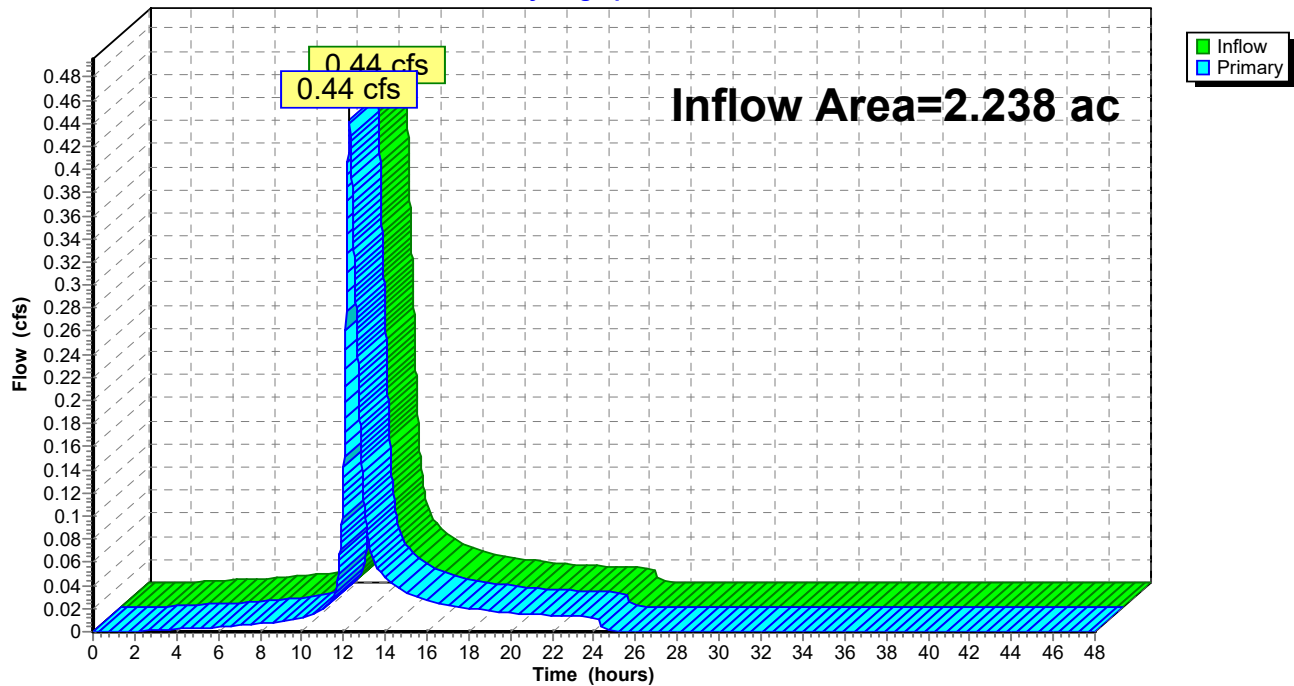
Summary for Link 5L: POA #2

Inflow Area =   9.342 ac, Inflow Depth =   1.11"   for 1-yr event
Inflow   =   13.94 cfs @   12.04 hrs, Volume=   0.868 af
Primary   =   13.94 cfs @   12.04 hrs, Volume=   0.868 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 5L: POA #2
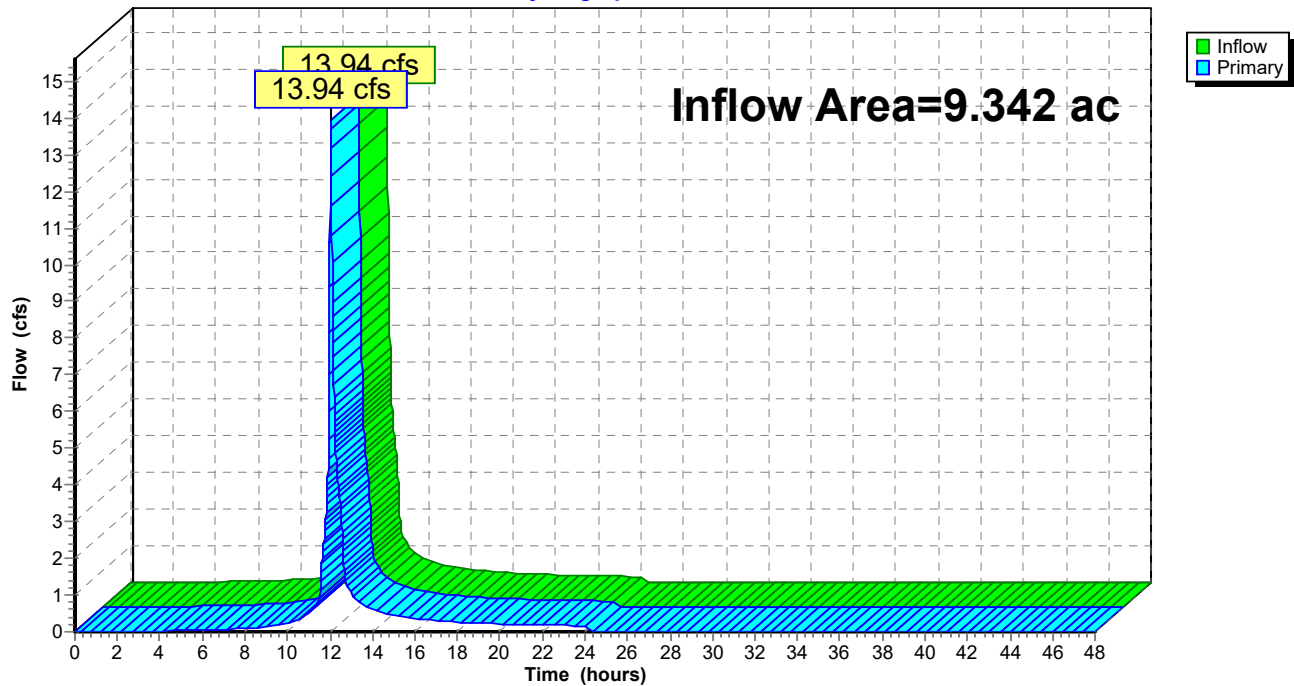
Summary for Link 8L: ENERGY BALANCE MAX Q REDUCTION

Inflow Area =   0.354 ac, Inflow Depth =   0.87"   for 1-yr event
Inflow   =   0.43 cfs @   12.04 hrs, Volume=   0.026 af
Primary   =   0.14 cfs @   12.04 hrs, Volume=   0.009 af, Atten= 66%, Lag= 0.0 min
Secondary =   0.28 cfs @   12.04 hrs, Volume=   0.017 af

Primary outflow = Inflow x 0.34, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: ENERGY BALANCE MAX Q REDUCTION
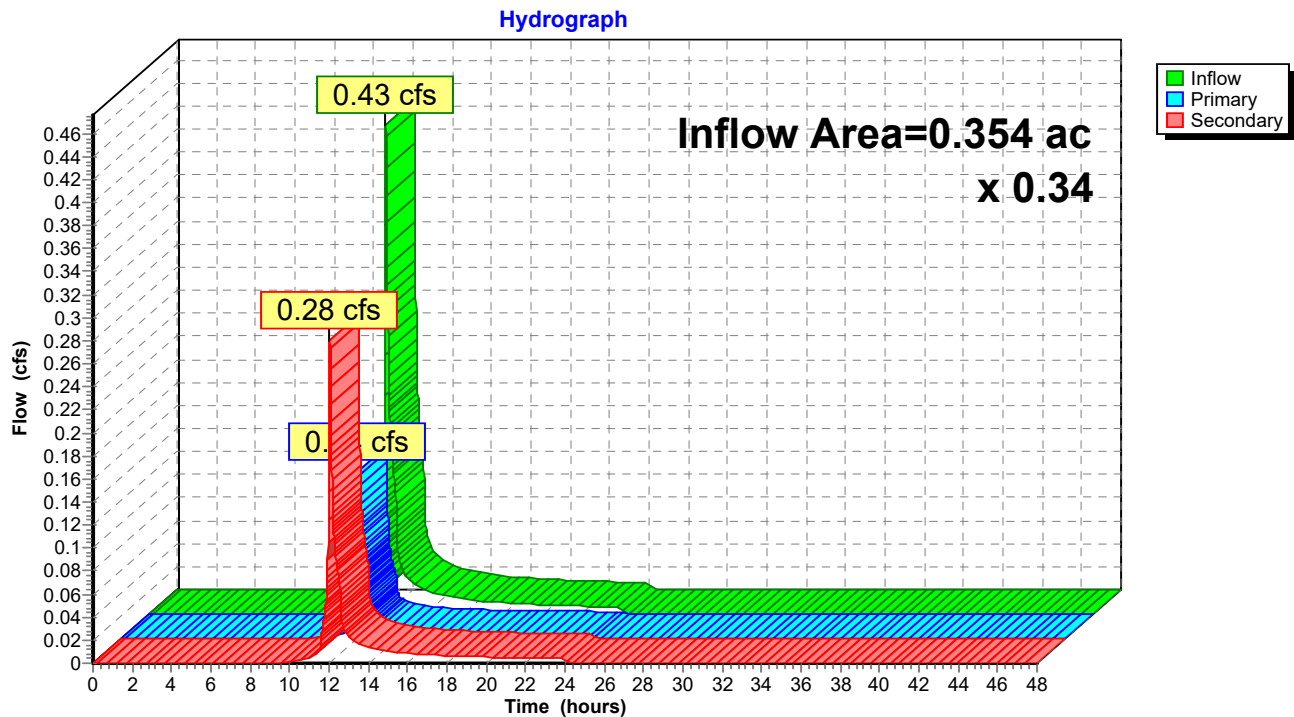
WATER QUALITY

Project Name: Timbre Apartments
Date: 8/1/2018
Linear Development Project? No

CLEAR ALL

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 4.46

Maximum reduction required:	20%
The site's net increase in impervious cover (acres) is:	2.749
Post-Development TP Load Reduction for Site (lb/yr):	5.16

Check:
BMP Design Specifications List: 2013 Draft Stds & Specs
Linear project? No
Land cover areas entered correctly? ✔
Total disturbed area entered? ✔

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed forest/open space		0.62	1.36		1.98
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed		0.08	2.05		2.13
Impervious Cover (acres)		0.04	0.31		0.35
					4.46

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land		0.01	0.07		0.09 *
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed		0.25	1.03		1.28
Impervious Cover (acres)		0.47	2.63		3.10
Area Check	OK.	OK.	OK.	OK.	4.46

* Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	1.98	0.26
Weighted Rv(forest)	0.04	0.03
% Forest	44%	15%
Managed Turf Cover (acres)	2.13	1.11
Weighted Rv(turf)	0.22	0.22
% Managed Turf	48%	65%
Impervious Cover (acres)	0.35	0.35
Rv(impervious)	0.95	0.95
% Impervious	8%	20%
Total Site Area (acres)	4.46	1.71
Site Rv	0.20	0.34

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0727	0.0485
Pre-ReDevelopment Treatment Volume (cubic feet)	3,168	2,115
Pre-ReDevelopment TP Load (lb/yr)	1.99	1.33
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	0.45	0.78
Baseline TP Load (lb/yr) (0.41 lbs/acre/yr applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		0.70

[1] Adjusted Land Cover Summary:
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requirement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.09
Weighted Rv(forest)	0.04
% Forest	2%
Managed Turf Cover (acres)	1.28
Weighted Rv (turf)	0.22
% Managed Turf	29%
Impervious Cover (acres)	3.10
Rv(impervious)	0.95
% Impervious	69%
Final Site Area (acres)	4.46
Final Post Dev Site Rv	0.72

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.09
Weighted Rv(forest)	0.04
% Forest	5%
Managed Turf Cover (acres)	1.28
Weighted Rv (turf)	0.22
% Managed Turf	75%
ReDev. Impervious Cover (acres)	0.35
Rv(impervious)	0.95
% Impervious	20%
Total ReDev. Site Area (acres)	1.71
ReDev Site Rv	0.36

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	2.75
Rv(impervious)	0.95

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	0.2686	Post-ReDevelopment Treatment Volume (acre-ft)	0.0509	Post-Development Treatment Volume (acre-ft)	0.2176
Final Post-Development Treatment Volume (cubic feet)	11,699	Post-ReDevelopment Treatment Volume (cubic feet)	2,219	Post-Development Treatment Volume (cubic feet)	9,480
Final Post-Development TP Load (lb/yr)	7.35	Post-ReDevelopment Load (TP) (lb/yr)*	1.39	Post-Development TP Load (lb/yr)	5.96
Final Post-Development TP Load per acre (lb/acre/yr)	1.65	Post-ReDevelopment TP Load per acre (lb/acre/yr)	0.81		
		Max. Reduction Required (Below Pre-ReDevelopment Load)	20%		
		TP Load Reduction Required for Redeveloped Area (lb/yr)	0.33	TP Load Reduction Required for New Impervious Area (lb/yr)	4.83

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	5.16

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	14.24	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	52.58

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: **2013 Draft Stds & Specs**

Site Summary

Project Title: Timbre Apartments

Date: 43313

Total Rainfall (in):	**43**
Total Disturbed Acreage:	**4.46**

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.62	1.36	0.00	1.98	44
Managed Turf (acres)	0.00	0.08	2.05	0.00	2.13	48
Impervious Cover (acres)	0.00	0.04	0.31	0.00	0.35	8
					4.46	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total	
Forest/Open (acres)	0.00	0.01	0.07	0.00	0.09	2	*
Managed Turf (acres)	0.00	0.25	1.03	0.00	1.28	29	
Impervious Cover (acres)	0.00	0.47	2.63	0.00	3.10	69	
* Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method					4.46	100	

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.72	0.36	0.95	0.34
Treatment Volume (ft^3)	11,699	2,219	9,480	2,115
TP Load (lb/yr)	7.35	1.39	5.96	1.33

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
0.78	**1.65**	**0.81**

Total TP Load Reduction Required (lb/yr)	**5.16**	0.33	4.83

	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	52.58	14.24

Site Compliance Summary

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%

Total Runoff Volume Reduction (ft^3)	0
Total TP Load Reduction Achieved (lb/yr)	0.00
Total TN Load Reduction Achieved (lb/yr)	0.00
Remaining Post Development TP Load (lb/yr)	7.35
Remaining TP Load Reduction (lb/yr) Required	**5.16**